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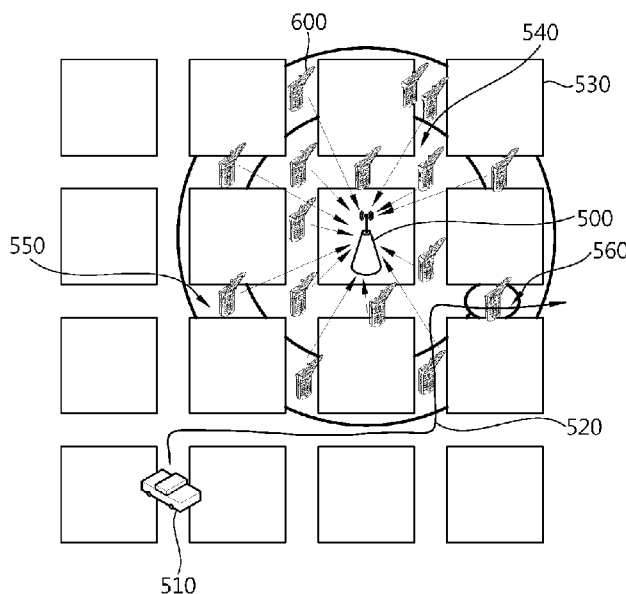
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(54) Title: METHOD FOR OBTAINING INFORMATION IN WIRELESS COOMMUNICATION SYSTEM AND APPARATUS THEREOF USING MDT

[Fig. 2]



(57) Abstract: Disclosed are an apparatus and method for collecting information using an MDT (Minimization Driving Test) in a wireless communication system, including: setting a log environment based on a log configuration request message; performing an MDT according to the set log environment and creating a log; and reporting the created log. The MDT is any one of a periodic MDT mode, an event triggered MDT mode, and a mixture mode of mixedly using the periodic MDT and the event triggered MDT, and the log configuration request message includes parameters regarding an object of an MDT measurement, a duration of an MDT measurement, a period of an MDT measurement, a log report scheme, a log report period, and a time of a base station, or a parameter regarding an occurrence of a triggering event initiating an MDT measurement.

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Description

Title of Invention: METHOD FOR OBTAINING INFORMATION IN WIRELESS COOMMUNICATION SYSTEM AND APPARATUS THEREOF USING MDT

Technical Field

- [1] The present invention relates to wireless communication technique and, more particularly, to an apparatus and method for establishing an environment for a minimization driving test (MDT).

Background Art

- [2] In order to enhance the performance of a wireless communication system, a wireless communication network must consider throughput, frequency efficiency, mobility, coverage, and a multimedia broadcast/multimedia service (MBMS) all the time. The respective factors affecting the wireless communication network have been greatly changed according to an advancement of a wireless communication technique.
- [3] For example, a wireless communication system generally uses a single bandwidth for data transmission, and respective mobile communication generation use different bandwidths. For example, a 2nd-generation wireless communication system uses a bandwidth of 200 KHz to 1.25 MHz, a 3rd-wierless communication system uses a bandwidth of 5 MHz to 10 MHz. In order to support an increasing transmission capacity, recently, LTE (Long Term Evolution) or IEEE 802.16m continue to extend their bandwidth to 20 MHz or even higher.
- [4] Thus, it may be requisite to increase the bandwidth to enhance transmission capacity, but it is not easy to allocate frequency of a large bandwidth due to insufficient frequency resources, except for some areas globally.
- [5] For an effective mobile communication system operation, service provides must consider various conditions according to an environment. Namely, service providers must consider how to use insufficient frequency resources as mentioned above, how large a cell radius is to be in establishing a base station, how much frequency requirements of cells are to be, or the like,
- [6] In order to effectively operate a system while maintaining high QoS (Quality of Service), service providers may need to recognize a coverage environment of a network, e.g., a call quality state within a cell or a signal transmission and reception state of each area.

Disclosure of Invention

Technical Problem

- [7] Therefore, an object of the present invention is to provide an apparatus and method for effectively measuring radio call coverage and radio call quality of mobile communication.
- [8] Another object of the present invention is to provide an apparatus and method for effectively measuring radio call coverage and radio call quality without measuring call quality within traffic coverage while directly moving.
- [9] Another object of the present invention is to provide an apparatus and method for accurately and specifically measuring radio call coverage and radio call quality.
- [10] Another object of the present invention is to provide an apparatus and method for effectively controlling an MDT (Minimization Driving Test) procedure even when handover is performed.
- [11] Another object of the present invention is to provide an apparatus and method for controlling performing of an MDT when handover is performed to thus preventing power consumption and a waste of a memory.

Solution to Problem

- [12] According to an aspect of the present invention, there is provided a method for collecting information using an MDT (Minimization Driving Test) procedure in a wireless communication system, including: transmitting a log configuration request message for an MDT; and requesting a log report.
- [13] The log configuration request message may include an MDT configuration parameter, and the MDT configuration parameter may include parameters regarding at least one of an object of an MDT measurement, a duration of an MDT measurement, a period of an MDT measurement, a log report scheme, a log report period, and a time of a base station.
- [14] The MDT configuration parameter included in the log configuration request message may include a parameter regarding an occurrence of a triggering event initiating an MDT measurement.
- [15] The method may further include: determining whether or not an MDT configuration is required to be changed, after the log configuration request message is transmitted, wherein when it is determined that the MDT configuration is required to be changed, a new MDT configuration parameter is configured and transmitted.
- [16] According to another aspect of the present invention, there is provided a method for collecting information using an MDT (Minimization Driving Test) in a wireless communication system, including: setting a log environment based on a log configuration request message; performing an MDT according to the set log environment and creating a log; and reporting the created log.
- [17] The MDT may be any one of a periodic MDT mode, an event triggered MDT mode,

and a mixture mode of mixedly using the periodic MDT and the event triggered MDT.

- [18] The method may further include: determining whether or not an MDT mode is required to be changed, before the log is reported, wherein when it is determined that the MDT mode is required to be changed, the MDT mode is changed and each step of the information collecting method is performed according to the changed MDT mode.
- [19] The log configuration request message may include an MDT configuration parameter, and the MDT configuration parameter may include parameters regarding at least one of an object of an MDT measurement, a duration of an MDT measurement, a period of an MDT measurement, a log report scheme, a log report period, and a time of a base station.
- [20] The MDT configuration parameter included in the log configuration request message may include a parameter regarding an occurrence of a triggering event initiating an MDT measurement.
- [21] According to another aspect of the present invention, there is provided a method for processing an MDT (Minimization Driving Test) by a source base station (BS) when handover is performed in a wireless communication system, including: when it is determined that handover is required based on a measurement report received from a user equipment (UE) performing an MDT, transmitting a first MDT message regarding an MDT to a target BS; determining whether to continue the MDT in a target BS based on a second MDT transmitted by the target BS in response to the first message; and transmitting a third MDT message to the UE based on the determination.
- [22] The first MDT message may include at least one of the MDT information of the source BS and an indicator indicating whether or not the MDT can be performed.
- [23] The MDT information of the source BS may include at least one of MDT version/release information of the source BS, information regarding a time of the source BS, information regarding a period during which a log is ongoing, information regarding a log period/interval, information regarding an area in which an MDT measurement is performed, information regarding a PLMN (Public Land Mobile Network) ID available for an MDT, information regarding a list of MDT triggering events, and information regarding an MDT triggering event type.
- [24] The second MDT message may include at least one of MDT information of the target BS and an indicator indicating whether or not the MDT can be performed.
- [25] The MDT information of the target BS may include at least one of MDT version/release information of the target BS and MDT reconfiguration information according to MDT configuration of the target BS. The MDT reconfiguration information may include at least one of information regarding a time of the target BS, information regarding a period during which a log is processing, information regarding a log period/interval, information regarding an area in which an MDT measurement is

performed, information regarding a PLMN (Public Land Mobile Network) ID of a target cell, information regarding a list of MDT triggering events, and information regarding an MDT triggering event type.

[26] The third MDT message may include at least one of information indicating whether the target BS performs an MDT and MDT reconfiguration information according to an MDT configuration of the target BS.

[27] The MDT reconfiguration information may include at least one of information regarding a time of the target BS, information regarding a period during which a log is processing, information regarding a log period/interval, information regarding an area in which an MDT measurement is performed, information regarding a PLMN (Public Land Mobile Network) ID of a target cell, information regarding a list of MDT triggering events, and information regarding an MDT triggering event type.

[28] The third MDT message may be identical to the second MDT message.

[29] When the second MDT message is not received from the target BS, it may be determined that the MDT has not been performed in the target cell, and the third MDT message may be transmitted to the UE accordingly.

[30] At least one of the step of transmitting the first MDT message, the step of determining whether to perform an MDT, and the step of transmitting the third MDT message may be performed together with a handover procedure.

[31] According to another aspect of the present invention, there is provided a method for processing an MDT (Minimization Driving Test) by a target base station (BS) when handover is performed in a wireless communication system, including: checking an MDT state based on a first MDT message including at least one of MDT configuration information of a source BS and MDT continuation request received from the source BS; and transmitting a second MDT message including at least one of information regarding whether to continue the MDT and MDT reconfiguration information based on the MDT state check.

[32] When the target BS cannot process the first MDT message received from the source BS, it may not transmit the second MDT message.

[33] At least one of the step of checking the MDT state and the step of transmitting the second MDT message may be performed together with a handover procedure.

[34] According to another aspect of the present invention, there is provided a method for processing an MDT (Minimization Driving Test) by a user equipment (UE) when handover is performed in a wireless communication system, including: transmitting a certain measurement report to a source base station (BS); and changing an MDT configuration based on an MDT message including at least one of MDT reconfiguration information and an indication regarding whether to continue an MDT in a target cell received from the source BS.

- [35] The changing of the MDT configuration may be changing of the MDT configuration into any one of maintaining an MDT configuration, stopping the MDT, and resetting the MDT.
- [36] According to another aspect of the present invention, there is provided a method for collecting information using an MDT (Minimization Driving Test) in a wireless communication system, including: transmitting a log configuration request message for an MDT; requesting a log report; and receiving a log report, wherein the log report is generated by at least one MDT mode of a periodic MDT mode and an event triggered MDT mode, and in requesting the log report, MDT mode information indicating the at least one MDT mode may be transferred.
- [37] The MDT mode information indicating the MDT mode may indicate changing of a current MDT mode of the log report into a certain MDT mode, and a log report received after the MDT mode information is transmitted may be generated by the certain MDT mode. The certain MDT mode may be an event triggered MDT mode, and the report may include information measured as a certain event occurs.
- [38] The log configuration request message may include an MDT configuration parameter, and the MDT configuration parameter may include parameters regarding at least one of an object of an MDT measurement, a duration of an MDT measurement, a period of an MDT measurement, a log report scheme, a log report period, a time of a base station, and an occurrence of a triggering event initiating an MDT measurement.
- [39] The method may further include: determining whether the MDT configuration is required to be changed; and when it is determined that the MDT configuration is required to be changed, a new MDT parameter may be configured and transmitted.
- [40] According to another aspect of the present invention, there is provided a method for collecting information using an MDT (Minimization Driving Test) in a wireless communication system, including: transmitting a log configuration request information for an MDT; indicating changing of an MDT configuration; and receiving a log report, wherein, in the indicating of changing of an MDT configuration, an MDT mode may be designated as at least one of a periodic MDT mode and an event triggered MDT mode.
- [41] The log configuration request message may include an MDT configuration parameter, and the MDT configuration parameter may include parameters regarding at least one of an object of an MDT measurement, a duration of an MDT measurement, a period of an MDT measurement, a log report scheme, a log report period, a time of a base station, and an occurrence of an event in the MDT mode and the event triggered MDT mode.
- [42] The indicating of changing of an MDT configuration may include: transmitting a log configuration request message including a new MDT configuration parameter or

transmitting a new MDT configuration parameter as a separate message.

[43] According to another aspect of the present invention, there is provided a method for transmitting information using an MDT (Minimization Driving Test) in a wireless communication system, including: setting a log environment based on an MDT configuration parameter included in a log configuration request message; performing an MDT and creating a log according to the set log environment; and transmitting a log report regarding the created log, wherein the MDT may be performed by any one of a periodic MDT mode, an event triggered MDT mode, and a mixture mode of mixedly using the periodic MDT and the event triggered MDT, and the MDT mode may be changed according to an MDT mode indication or an occurrence of a certain event.

[44] The MDT mode indication may be included in the log configuration request message or may be received through a separate message, and when the MDT mode indication indicates the periodic MDT mode, a current MDT performing mode may be changed into the periodic MDT mode in which a measurement regarding an MDT is periodically performed, when the MDT mode indication indicates the event triggered MDT mode, the current MDT performing mode may be changed into the event triggered MDT mode in which a measurement regarding an MDT is performed when a certain event occurs, and when the MDT mode indication indicates the mixture mode, the current MDT performing mode may be changed into the mixture mode in which the periodic MDT mode and the event triggered MDT mode are performed together.

[45] The information regarding a certain event for changing the MDT mode may be included in the MDT configuration parameter included in the log configuration request message.

[46] The log configuration request message may include the MDT configuration parameter, and the MDT configuration parameter may include parameters regarding at least one of an object of an MDT measurement, a duration of an MDT measurement, a period of an MDT measurement, a log report scheme, a log report period, a time of a base station, the MDT mode, an occurrence of an event in the event triggered MDT mode, and an occurrence of an event for changing the MDT mode.

[47] According to another aspect of the present invention, there is provided an apparatus for collecting information, including processor configuring MDT (Minimization Driving Test) parameter and log configuration request for MDT and RF (Radio Frequency) unit transmitting the log configuration request and log report request, and receiving log report, wherein the log report is generated by at least one MDT mode of a periodic MDT mode and an event triggered MDT mode, and the log report request includes MDT mode information indicating the at least one MDT mode. The processor configures change request for changing MDT configuration and transmitting the change request through the RF unit, and the change request indicates one of the

periodic MDT mode and the event triggered MDT mode.

- [48] According to another aspect of the present invention, there is provided an apparatus for transmitting information, including processor setting a log environment based on an MDT (Minimization Driving Test) parameter and creating a log with MDT and RF (Radio Frequency) unit transmitting a log report regarding the created log, wherein the MDT is performed by any one MDT mode of a periodic MDT mode, an event triggered MDT mode, and a mixture mode of mixedly using the periodic MDT and the event triggered MDT, and the MDT mode is changed according to an MDT mode indication or an occurrence of a certain event.

Advantageous Effects of Invention

- [49] According to an embodiment of the present invention, wireless call coverage and wireless call quality of mobile communication can be effectively measured.
- [50] According to an embodiment of the present invention, wireless call coverage and wireless call quality can be effectively measured without directly measuring call quality while moving traffic coverage.
- [51] According to an embodiment of the present invention, an MDT (Minimization Driving Test) can be effectively controlled even when handover is performed, and power consumption and a waste of a memory of a user equipment (UE) can be prevented.

Brief Description of Drawings

- [52] FIG. 1 is a schematic conceptual view showing a driving test.
- [53] FIG. 2 is a schematic conceptual view showing a minimization driving test (MDT).
- [54] FIG. 3 is a flow chart schematically explaining an MDT configuration method.
- [55] FIG. 4 is a schematic conceptual view explaining an example of forming a log in a periodic MDT.
- [56] FIG. 5 is a flow chart schematically explaining a method for configuring an event triggered MDT.
- [57] FIG. 6 is a schematic conceptual view explaining an example of creating a log in a mixture scheme using both a periodic scheme and an event triggered scheme.
- [58] FIG. 7 is a flow chart schematically explaining an operation of a network with respect to an MDT measurement.
- [59] FIG. 8 is a flow chart schematically explaining an operation of a UE with respect to an MDT measurement.
- [60] FIG. 9 is a flow chart schematically explaining performing of an MDT control procedure together with a handover preparation procedure performed between a source base station and a target base station in a system to which the present invention is applied.

[61] FIG. 10 is a flow chart schematically explaining performing of an MDT control procedure together with a handover procedure performed between a UE and a source base station in a system to which the present invention is applied.

[62] FIG. 11 is a flow chart schematically explaining MDT controlling performed by a source base station when a handover procedure is performed in a system to which the present invention is applied.

[63] FIG. 12 is a flow chart schematically explaining MDT controlling performed by a target base station when a handover procedure is performed in a system to which the present invention is applied.

[64] FIG. 13 is a flow chart schematically explaining MDT controlling performed by a UE when a handover procedure is performed in a system to which the present invention is applied.

[65] FIG. 14 is a schematic block diagram of a wireless communication system in which an embodiment of the present invention is implemented.

Mode for the Invention

[66] Embodiments of the present invention will now be described in detail with reference to the accompanying drawings. It should be understood that, in applying reference numerals to constituents of each drawing, although the same constituents are shown on different drawings, they are denoted by the same reference numbers as possible. In describing the present invention, if a detailed explanation for a related known function or construction is considered to unnecessarily divert the gist of the present invention, such explanation will be omitted but would be understood by those skilled in the art.

[67] A user equipment (UE) may be mixed or mobile, and may be called by other names such as MS (UE), UT (User Terminal), SS (Subscriber Station), MT (Mobile Terminal), wireless device, or the like.

[68] A base station (BS) refers to a fixed station communicating with a UE, and may be called by other names such as eNB (evolved-NodeB), BTS (Base Transceiver System), access point, or the like.

[69] One or more cells may exist in one BS. Here, cells should be interpreted to have a comprehensive meaning indicating a partial area covered by a BS, and comprehensively include various coverage areas such as a mega-cell, a macro-cell, a micro-cell, a pico-cell, a femto-cell, a relay, or the like.

[70] An interface for user traffic or control traffic transmission may be used between BSs. The BSs may be connected through an X2 interface.

[71] A UE measures communication quality of a serving cell currently providing a service and that of neighbor cells around the serving cell, continuously or at every particular point in time.

- [72] The UE may use measurement values regarding a communication environment of a network in order to construct and operate a network system.
- [73] In general, in establishing a wireless communication network, a network provider optimizes a network such as a BS, a cell environment, or the like, by checking wireless call quality, whether or not a UE is out of range (or out of service zone) in relation to a cell radius, a coverage hold, or the like. For example, the UE may recognize the strength of a BS signal to recognize a call available location, or recognize a location in which the UE can hardly perform call communication due to attenuation of signals, or the like, and effectively cope with the situation. Or, the UE may recognize a shadow area in which the UE cannot perform call communication and use a measurement value of communication quality including signal strength of a BS in order to take measure to resolve the problem.
- [74] FIG. 1 is a schematic conceptual view showing a driving test of measuring wireless call quality and/or coverage, or the like, by using a vehicle. A network provider, or the like, moves within traffic coverage, i.e., a cell of a constructed BS 500 by using a vehicle 510.
- [75] As shown by a moving path 520 of the vehicle 510, the vehicle 510 collects call quality of the corresponding area by using a UE, or the like, mounted therein while passing through every place as possible within the cell. Call quality within the cell varies due to various factors such as the disposition of a building 530 or a geographical height, or the like, within the cell. For example, there may be areas 540 and 550 in which a call is available, and there may be a call shadow area 560. In addition, even among the call available areas, the area 540 may have good call quality while the area 550 may have bad call quality.
- [76] In general, call quality may differ according to the distance to the BS 500. For example, since the area 540 having good call quality is closer to the BS 500 than the area 550 having bad call quality does, so the area 540 may be anticipated to have better call quality in terms of transmission power. However, as mentioned above, call quality or a call state is affected by various factors. When a geographical affect such as the building 530, or the like, is considered, actual call quality of each area may be different from expectation. For example, although the area 560 is situated between buildings and is not distant from the BS, it may be a call shadow area.
- [77] Thus, in order to actually optimize the network, specific information regarding a communication environment within a network is required. To this end, however, making a driving test on every required place within the cell requires a great amount of time and labor force.
- [78] Thus, a method for measuring quality with respect to a communication environment within a network without measuring call quality while directly in motion in every

possible area within the cell through a vehicle, or the like, may be considered. Namely, a scheme (minimization driving test (MDT)) of measuring call quality within a network while minimizing a driving test may be considered.

[79] FIG. 2 is a schematic conceptual view showing measurement of a communication environment, e.g., wireless call quality and/or coverage, or the like, of a network by using the MDT.

[80] Measuring call quality within the cell while directly moving in a vehicle, or the like, is minimized and a wireless communication environment and a coverage situation are checked through communication quality at several locations within the cell which is reported and measured by each UE. By utilizing the values measured by UEs scattered in various areas, an area in which a UE can perform call communication, an area in which a UE can hardly perform call communication due to a signal attenuation, or the like, or an area in which a UE cannot perform call communication, or the like, within the cell can be easily recognized, like an actual driving test.

[81] With reference to FIG. 2, in order to measure wireless call quality, a plurality of UEs 600 scattered in the cell can be used, so the measurement vehicle 510 may move only along a minimum path 520.

[82] Besides the measurement performed by the vehicle 510, measurement of a wireless environment is performed by a plurality of UEs at several locations within the cell. Each of the UEs may measure the wireless environment according to a current location according to an MDT configuration.

[83] Here, information obtained by measuring the wireless environment by each UE for the MDT is called log. A UE may continuously accumulate whenever it measures a state of the wireless communication environment, and store it in the form of a new log. A UE may transmit information indicating that the UE currently has a log accumulated by performing MDT, to a network or a BS. When the UE receives information regarding the log from the network or the BS, the UE may transmit the corresponding log information to the corresponding network or the BS.

[84] FIG. 3 is a flow chart schematically explaining a method for configuring an MDT. The network configures an MDT configuration parameter (S710). Here, the network has a concept including all of a UTRAN of 3GPP of a BS (eNB) or a higher entity of the BS, an E-UTRAN of LTE, a UMTS of WCDMA, or the like, rather than a simple network or a core network. Hereinafter, in the present disclosure, the network may be used as a concept including all of a UTRAN of 3GPP of a BS (eNB) or higher than the BS, an E-UTRAN of LTE, a UMTS of WCDMA, or the like, rather than a simple network or a core network. Thus, the BS may configure the MDT configuration parameter or an entity higher than the BS may configure the MDT configuration parameter.

- [85] The MDT configuration parameter configured in the network may include an object of an MDT measurement, a duration of an MDT measurement, a period of an MDT measurement, a log report scheme, a log report period, a time of a base station, and the like.
- [86] In order to obtain information regarding a communication state or call quality of the network, the network may set an object to be measured by the UE through the parameter regarding an object of an MDT measurement. The object of an MDT measurement may be limited to signal quality of a serving cell or may be set to include even signal strength of a signal transmitted from a BS of a neighbor cell as necessary.
- [87] The network may set a duration in which an MDT measurement is made and a measurement period in the corresponding measurement duration through the parameter regarding the duration and period of the MDT measurement. In this connection, it may be such that an MDT measurement is performed in a certain duration and then terminated, or it may be set such that the MDT measurement is performed in a certain duration at every certain time periodically.
- [88] The network may set a scheme of transferring the results of the MDT measurement from the UE to the network through the parameter regarding a log report scheme. As for the report of log information, when the network requests the UE to report the log, the UE may report the log information to the network. The UE may transmit information indicating that the UE currently has a log accumulated by performing the MDT to the network or the BS. After recognizing the state of the log of the UE received from the UE, the network may request the UE to report the log. Also, even without an explicit request from the network, the UE may report the log information to the network when a certain time has lapsed after the MDT measurement was started. Also, the UE may report the log information at every certain time periodically.
- [89] When it is set such that the log information is reported at every certain time, the network may set a report period of the log information through the parameter regarding a log report period. In this case, the network may perform an MDT on each of the foregoing MDT measurement objects and may set a report period of log information such that it is different for each of the MDT measurement objects. Also, the network may set such that a log regarding some of the foregoing MDT measurement objects is periodically reported and a log regarding some other of the foregoing MDT measurement objects is reported only when there is an explicit request from the network.
- [90] The network may set a reference time regarding the MDT measurement value through the parameter regarding a time of a BS.
- [91] Here, some parameters related to the MDT configuration have been described, but the parameters regarding the MDT configuration may be variably configured according to the necessity of network optimization, in addition to the foregoing parameters. For

example, in relation to the log report scheme, it is set such that a log is reported only when there is an explicit log report request from the network, but a parameter regarding how to handle the logs accumulated in the interim if there is no explicit request from the network may also be set. Also, the existing MDT configuration parameter may be corrected or deleted, or a new MDT configuration parameter may be added to the existing MDT configuration parameter.

[92] The BS includes the MDT configuration value in a log configuration request message and transmits the same to the UE (S720). The log configuration request message includes relevant information required for the UE to perform the MDT measurement. The log configuration request message may include an indicator for initiating an MDT measurement. Also, the log configuration request message may be an indicator for initiating an MDT measurement.

[93] The log configuration request message may be configured according to MDT configuration parameters such as an object of an MDT measurement, a duration of an MDT measurement, a period of an MDT measurement, a log report scheme, a log report period, a time of a BS, and the like.

[94] The UE may receive the log configuration request message from the BS and configure a log environment according to the MDT configuration (S730).

[95] When log information is required, the network may request log information from the UE (S740). Upon receiving the log information request from the network, the UE may create a log information report based on the created log (S750). Or, the UE may be in a state in which it logs according to the log configuration request message and stores a finally obtained log, and in this state, the UE may use the stored log information immediately as a log information report. Subsequently, the UE may transfer the created log information report to the network (S760). Here, it is described that the UE transfers the log report to the network only when there is a log information request from the network, but the present invention is not limited thereto and the UE may report log information to the network although there is no explicit log information request from the network according to pre-set conditions.

[96] The MDT may be classified into an IMDT (Immediate MDT) and an LMDT (Logged MDT) according to a mode in which a measurement is performed. In both of the IMDT and the LMDT, the UE receives an MDT configuration in an RRC_CONNECTED mode. Or, some MDT configurations may be transmitted through SI (System Information).

[97] Regarding measurement, in case of the IMDT, the UE in the RRC_CONNECTED mode performs measurement according to the MDT configuration at a certain period. Also, the UE in the RRC_CONNECTED mode may perform measurement when a triggering event occurs according to a BS's instruction or as predetermined.

- [98] The UE logs the measurement results. For example, the UE may log when an RLF (Radio Link Failure) occurs. The UE may transfer information indicating that the UE is in a state of being able to report the log, to the BS, accordingly, the BS can recognize that the corresponding UE is in a state of being able to report MDT. The BS may request the UE to report the MDT.
- [99] In case of the IMDT, the BS may include a message requesting an MDT report along with the forgoing channel information in a message requesting information regarding measurement generally performed by the UE. Upon receiving the MDT report request message, the UE transmits an MDT report message to the corresponding BS based on the measured log. Also, in case of the event triggered MDT, when a corresponding event occurs, the UE may perform measurement regarding an MDT and immediately report the measurement results to the BS.
- [100] Regarding measurement, in the case of the LMDT, the UE performs measurement in an RRC_IDLE mode. The UE in the RRC_IDLE mode may perform measurement at every certain period according to an MDT configuration. For example, the UE may wake up at every certain period, namely, at every period set by certain multiples of a period 'On Duration' of DRX to perform measurement according to the MDT configuration. Also, when a triggering event occurs according to a BS's instruction or as predetermined, the UE may perform measurement. After performing measurement according to the MDT configuration, the UE logs the measurement results. The UE in the RRC_IDLE mode may access a cell through, for example, a cell selection/res-election process. Here, the UE may transfer information indicating that the UE is in a state of being able to report the log, to the BS through the cell accessing process, and accordingly, the BS can recognize that the corresponding UE is in a state of being able to report MDT. The BS may request the UE to report the MDT. The BS may include a message requesting the MDT report in an information request message and transmit the same. Upon receiving the MDT report request message, the UE transmits the MDT report message to the corresponding BS based on the log.
- [101] Also, the MDT may be classified into a periodic MDT and an event triggered MDT according to a method in which measurement is performed.
- [102] FIG. 4 is a schematic conceptual view explaining an example of forming a log in the periodic MDT.
- [103] With reference to FIG. 4, the UE performs measurement on a network communication environment at every measurement point in time $T_1 \sim T_5$ according to an MDT measurement period T_M in an MDT measurement duration T_{on} . The MDT measurement duration and/or MDT measurement period may be configured as configuration parameters of the periodic MDT by the network.
- [104] In the example of FIG. 4, the MDT measurement period T_M is set as a multiple of

DRX cycle T_d . In order to reduce power consumption in a UE reception circuit, the LTE, or the like, supports DRX (Discontinuous Reception) and this corresponds to a CPC (Continuous Packet Connectivity) function of HSPA, or the like. When the DRX cycle is designated, the UE observes downlink control signaling in a single subframe per DRX cycle, and maintains a sleep mode in other subframes. In the periodic MDT, the DRX cycle may be utilized as a reference of setting the MDT measurement period.

- [105] The UE measures a network communication environment, or the like, according to the MDT configuration and creates a log, measurement information. The log is continuously accumulated at every measurement and stored in a new log form in the UE. As shown in an example of a log illustrated in FIG. 4, a log number according to a measurement point in time may be indicated in a log in order to identify the log, and the log may include a measured wireless communication environment value, a time stamp with respect to a measurement time, measurement location information, or the like. Here, it is described that the log includes the measurement value with respect to a wireless communication environment, the time stamp, and the location information, but the present invention is not limited thereto and each log may include various types of information as necessary.
- [106] As described above, in the case of the periodic MDT, the UE measures network communication quality according to a pre-set period in a pre-set duration and creates/stores/manages a log.
- [107] Along with such a periodic MDT, in order to more accurately recognize call quality within the cell, a method of using an MDT triggered by an event may be considered.
- [108] FIG. 5 is a flow chart schematically explaining a method for configuring an event triggered MDT.
- [109] A network configures a scheme of an event triggered MDT (S910). Here, the network has a concept including all of a UTRAN of 3GPP of a BS (eNB) or a higher entity of the BS, an E-UTRAN of LTE, a UMTS of WCDMA, or the like, rather than a simple network or a core network. Thus, a parameter related to the MDT configuration may be configured by the BS or a higher entity of the BS. The network may separately configure the event triggered MDT discriminated from the periodic MDT, or may configure the event triggered MDT through configuration of the periodic MDT.
- [110] The parameter configured for the event triggered MDT may include information regarding a type of a triggering event. Also, the parameter configured for the event triggered MDT may include information regarding a log creation and/or log information report, or the like.
- [111] There may be various triggering events with respect to the MDT measurement, and the network may select a desired triggering event as necessary from among the various triggering events. For example, events which may be used by the event triggered MDT

may be a case in which location information of the UE is updated, a case in which a network state measured by the UE is changed, a case in which an operation of the UE or an operation of the BS fails, or the like.

[112] The network includes the event triggered MDT configuration parameter in a log configuration request message and transmits the same to the UE (S920). The log configuration request message may include an indicator for initiating the an event triggered MDT measurement. Also, the log configuration request message may be an indicator for initiating the event triggered MDT measurement. Here, it is described that the event triggered MDT configuration parameter is included in the log configuration request message and transmitted, but the event triggered MDT configuration parameter may be included in a message other than the log configuration request message and transmitted to the UE. Also, the network may configure a message including only the event triggered MDT configuration parameter and transmit the same to the UE. When transmitting the event triggered MDT configuration parameter, the BS may provide information regarding the transmission to the UE through a separate notification.

[113] The UE may configure a log environment based on the message received from the BS (S930). When the received message includes only the event triggered MDT configuration parameter, the UE may configure a log environment based on the event triggered MDT configuration. When the received message is, for example, a log configuration request message and includes the parameter regarding the event triggered MDT configuration, the UE may configure a log environment based on the event triggered MDT configuration as well as configure a log environment based on the MDT configuration of the log configuration request message.

[114] When log information is required, the network may request the log information from the UE (S940). Upon receiving log information request from the network, the UE may create a log report based on a created log (S950). Subsequently, the UE transfers the created log report to the network (S960). The log report may be final log information stored through the configured log.

[115] Here, it is described that the UE transfers the log report to the network when the log information request is received from the network, but the present invention is not limited thereto and the UE may report the log information to the network although there is no explicit log information request from the network, according to pre-set conditions.

[116] The event triggered MDT performs MDT measurement according to an occurrence of the foregoing triggering event. When the triggering event occurs, the UE may perform an MDT measurement and create a log according to a predetermined certain rule or instruction. Or, when the triggering event occurs, the UE may perform an MDT measurement and create a log only when there is an explicit request from the base

station or the network.

[117] Also, in the case of the event triggered MDT, when the network requests a report of the log from the UE, the UE may report the log information to the network. Also, even without an explicit request from the network, the UE may report the log information when a certain time has lapsed after the MDT measurement.

[118] Meanwhile, as mentioned above, there may be various triggering events for the network to request MDT measurement, and the network may select a desired triggering event as necessary. Hereinafter, (1) the case in which location information of the UE is updated, (2) the case in which a network state measured by the UE is changed, and (3) the case in which an operation of the UE or an operation of the BS fails will be described as examples of the triggering events.

[119] (1) When location information of the UE is updated

[120] A method for recognizing a location of the UE may be divided into a network-based method and a handset-based method. A basic principle regarding a positioning scheme of the network-based method includes TDOA (Time Difference of Arrival), AOA (Angle of Arrival) and RF Fingerprint, and a basic principle regarding a positioning scheme of the handset-based method includes TOA (Time of Arrival) using GPS (Global Positioning System). Also, there is a hybrid positioning scheme combining the basic principles of such positioning schemes.

[121] A positioning scheme based on OTDOA (Observed TDOA), a scheme of measuring a location by observing a relative difference in time of arrival of propagation from two signal sources has been standardized. In LTE, a location checking scheme using LPP (LTE Positioning Protocol) is used. In WCDMA, a location of a UE is checked by using a UE positioning scheme.

[122] The UE may have a connection configuration with a network, or the like, providing a service based on position or positioning in order to receive location information or location updating information. Here, the network may be a base station and/or a server of a location-based server.

[123] When location information of the UE is changed like a case in which the location of the UE is changed according to a movement or a case in which a location information service is newly received to obtain location information, the UE can obtain the changed location information through the foregoing connection configuration, or the like,

[124] When the location information of the UE is changed, the UE may regard it as a triggering event for MDT measurement and may perform MDT measurement. After performing MDT measurement, the UE creates a log regarding measured information. The log may include location information at the time of the measurement and a time stamp.

- [125] When the changing of the location information is considered as a triggering event, the UE notify the network accordingly, receive a message including a parameter regarding changing of location information as a parameter regarding event triggered MDT configuration from the network, and perform MDT measurement.
- [126] Also, without receiving the message including a parameter regarding changing of location information from the network, the UE may perform MDT measurement by using the changing of location information as a triggering event. In this case, the network may transfer only an instruction that the changing of the location information will be used as a triggering event, instead of the parameter regarding changing of location information, to the UE to allow the MDT measurement to be performed.
- [127] Also, in case in which location information is changed between the UE and the BS or between the UE and the network, if there has been a certain rule or indication that the changing of the location information will be considered as a triggering event, the UE may obtain information regarding the changed location information and perform MDT measurement.
- [128] (2) Measurement-based triggering event
- [129] The UE recognizes a wireless communication state such as signal strength, quality of a signal, or the like, provided from the BS through measurement continuously during a certain period of time or in a particular situation. Based on such a continuous signal measurement operation performed by the UE, the UE or the network may recognize a particular situation generated in the UE, set the particular situation as a triggering event, performs MDT measurement, and create the measurement value as a log. Which situation is to be considered as a triggering event may be previously set between the UE and the network.
- [130] For example, the UE may continuously measure whether or not a triggering event has occurred by using a DRX period. As shown in FIG. 4, when the period of measurement regarding a triggering event is set to be a multiple of the DRX period, the UE may determine whether or not conditions in which the triggering event has occurred are met at every period at which the occurrence of the triggering event is checked. When it is determined that the triggering event has occurred, the UE may generate an MDT log of a event-triggered scheme. Here, various values such as a threshold value, an offset, or the like, regarding a pre-set triggering event, may be used as the conditions for determining the occurrence of the triggering event.
- [131] A change in a communication state of the network may be considered as a triggering event based on measurement. Whether or not a measurement value regarding a state of a network, or the like, measured by the UE, or the like, is smaller or greater than a certain threshold value may be determined and utilized as the condition for an occurrence of a triggering event with respect to a change in the communication state of

the network.

- [132] Hereinafter, a case in which a measurement value regarding a network state, or the like, of a serving cell is greater than a certain threshold value, a case in which a measurement value regarding a network state, or the like, of a serving cell is smaller than a certain threshold value, and a case in which the measurement value is compared with a measurement value of a neighbor cell and the difference is greater than a certain offset will be described as examples of the triggering event.
- [133] - Triggering event 1: When a measurement value regarding a network state, or the like, is greater than a certain threshold value
- [134] The case in which a measurement value measured by a UE regarding a network state, or the like, is greater than a certain threshold value will be described as a triggering event 1. In this case, an event type, a threshold value of a corresponding event type, a hysteresis value of the corresponding event type, and the like, may be event triggered MDT configuration parameters.
- [135] When the measurement value is greater than the pre-set threshold value, it may be determined that the triggering event 1 occurs.
- [136] The triggering event 1 may be used for various cases. For example, when the event type is a change in signal strength, signal strength may be measured through the UE on the move and used in order to check a boundary where an area in which signal strength is weak is changed to an area in which signal strength is greater than a certain value, namely, in order to check a wireless communication network or coverage of a corresponding cell. When the event type is a change in the signal strength, a certain signal strength may be set as a threshold value and whether or not a triggering event has occurred may be determined by comparing a measurement value to the threshold value.
- [137] An event triggered MDT configuration parameter, e.g., an event type, a threshold value of a corresponding event type, a hysteresis value of the corresponding event type, or the like, may be configured by the network (BS or a control station), or the like.
- [138] Triggering conditions in the triggering event 1 will be described.
- [139] (a) $M_s \geq M_{Th}$ or $M_s > M_{Th}$
- [140] Here, M_s is a measurement value of a corresponding event type with respect to a serving cell, which may be, for example, reference signal received power (RSRP) or a reference signal received quality (RSRQ), and M_{Th} is a threshold value with respect to the corresponding event type. In case of the triggering condition (a), when the value M_s is greater than or equal to a threshold value or when the value M_s is greater than the threshold value, it is considered that the triggering event 1 occurs.
- [141] (b) $M_s - Hys > M_{Th}$: Event triggering starts
- [142] $M_s + Hys < M_{Th}$: Event triggering terminates

- [143] Here, M_s is a measurement value of a corresponding event type with respect to a serving cell, which may be, for example, reference signal received power (RSRP) or a reference signal received quality (RSRQ), and M_{Th} is a threshold value with respect to the corresponding event type. Hys is a hysteresis value with respect to the corresponding event type.
- [144] In case of using the triggering condition (b), when the difference between the value M_s and the hysteresis value is greater than M_{Th} , the event triggering starts, and when the sum of the value M_s and the hysteresis value is smaller than M_{Th} , the event triggering terminates.
- [145] - Triggering event 2: when a measurement value regarding a network state, or the like, is smaller than the certain threshold value.
- [146] The case in which a measurement value measured by a UE regarding a network state, or the like, is smaller than the certain threshold value will be described as a triggering event 2. In this case, an event type, a threshold value of a corresponding event type, a hysteresis value of the corresponding event type, and the like, may be event triggered MDT configuration parameters.
- [147] When the measurement value is smaller than the pre-set threshold value, it may be determined that the triggering event 2 occurs.
- [148] The triggering event 2 may be used for various cases. For example, when the event type is a change in signal strength, signal strength may be measured through the UE on the move and used in order to check a boundary where an area in which signal strength is weak is changed to an area in which signal strength is greater than a certain value, namely, in order to check a wireless communication network or coverage of a corresponding cell. When the event type is a change in the signal strength, a certain signal strength may be set as a threshold value and whether or not a triggering event has occurred may be determined by comparing a measurement value to the threshold value.
- [149] An event triggered MDT configuration parameter, e.g., an event type, a threshold value of a corresponding event type, a hysteresis value of the corresponding event type, or the like, may be configured by the network (BS or a control station), or the like.
- [150] Triggering conditions in the triggering event 2 will be described.
- [151] (a) $M_s \leq M_{Th}$ or $M_s < M_{Th}$
- [152] Here, M_s is a measurement value of a corresponding event type with respect to a serving cell, which may be, for example, reference signal received power (RSRP) or a reference signal received quality (RSRQ), and M_{Th} is a threshold value with respect to the corresponding event type. In case of the triggering condition (a), when the value M_s is smaller than or equal to a threshold value or when the value M_s is smaller than the threshold value, it is considered that the triggering event 2 occurs.

- [153] (b) $M_s + Hys < M_{Th}$: Event triggering starts
- [154] $M_s - Hys > M_{Th}$: Event triggering terminates
- [155] Here, M_s is a measurement value of a corresponding event type with respect to a serving cell, which may be, for example, reference signal received power (RSRP) or a reference signal received quality (RSRQ), and M_{Th} is a threshold value with respect to the corresponding event type. Hys is a hysteresis value with respect to the corresponding event type.
- [156] In case of using the triggering condition (b), when the sum of the value M_s and the hysteresis value is smaller than M_{Th} , the event triggering starts, and when the difference between the value M_s and the hysteresis value is greater than M_{Th} , the event triggering terminates.
- [157] - Triggering event 3: when a measurement value regarding a network state, or the like, is different by a certain offset or more from a measurement value of a neighbor cell.
- [158] The case in which a measurement value measured by a UE regarding a network state, or the like, is different by a certain offset or more from a measurement value of a neighbor will be described as a triggering event 2. In this case, an event type, a certain offset value with respect to measurement values of neighbor cells regarding a corresponding event type, and the like, may be event triggered MDT configuration parameters.
- [159] The triggering event 3 may be used as an event for recognizing a location, a point in time, or the like, at which the UE performs handover from a serving cell to a neighbor cell, and when the measurement value regarding the service cell is greater by a pre-set certain offset than the measurement values of neighbor cells, the event may be triggered. For example, when a measurement value of the neighbor cell regarding a network state, or the like, e.g., a measurement value of the neighbor cell regarding strength of a radio signal, measured by the UE on the move is greater than that of the current serving cell, the event may be triggered.
- [160] An event triggered MDT configuration parameter, e.g., an event type, a certain offset value with respect to measurement values of neighbor cells regarding a corresponding event type, or the like, may be configured by the network (a BS or a control station), or the like.
- [161] Triggering conditions in the triggering event 3 will be described.
- [162] (a) $M_n \geq M_s + Offset$ or $M_n > M_s + Offset$
- [163] Here, M_s is a measurement value of a corresponding event type with respect to a serving cell, which may be, for example, reference signal received power (RSRP) or a reference signal received quality (RSRQ), and M_n is a measurement value of a neighbor cell with respect to the same event type as that of M_s . Also, Offset is a certain

offset value with respect to a corresponding event type. In case of the triggering condition (a), when the value M_n is greater by an offset or more than the value M_s or equal to, or when the value M_n is greater by the offset than the value M_s , it is considered that the triggering event 3 occurs.

[164] (b) $M_n - Hys > M_s + Offset$: Event starts

[165] $M_n + Hys < M_s + Offset$: Event terminates

[166] Here, M_s is a measurement value of a corresponding event type with respect to a serving cell, which may be, for example, reference signal received power (RSRP) or a reference signal received quality (RSRQ), and M_n is a measurement value of a neighbor cell with respect to the same event type as that of M_s . Also, Offset is a certain offset value with respect to a corresponding event type and Hys is a hysteresis value with respect to the corresponding event type.

[167] In case of using the triggering condition (b), when the difference between the value M_n and the hysteresis value is greater than the sum of the value M_s and the Offset, event triggering starts, and when sum of the value M_n and the hysteresis value is smaller than the sum of the value M_s and the Offset, event triggering terminates.

[168] So far, the case in which the measurement with respect to a network state, or the like, of the serving cell is greater than a certain threshold value, the case in which the measurement with respect to a network state, or the like, of the serving cell is smaller than a certain threshold value, and the case in which the measurement with respect to a network state, or the like, of the serving cell is greater by a certain offset than a measurement value of a neighbor cell have been described as examples of the triggering events, but the triggering event which can be used in the event triggered MDT scheme is not limited thereto, and event triggered MDT measurement can be made by using various triggering events.

[169] As described above, the MDT configuration scheme may be divided into a periodic MDT scheme and an event triggered MDT scheme. When a network environment is required to be specifically recognized according to a particular situation of a UE or a network, the event triggered MDT scheme may be used in addition to the periodic MDT scheme. The periodic MDT scheme and the event triggered MDT scheme may be used alone or together. Thus, in operating the MDT scheme, the MDT mode of the UE may be divided into the following three types of modes.

[170] (1) Periodic scheme (Type 1)

[171] (2) Event-triggered scheme (Type 2)

[172] (3) Mixture scheme of periodic scheme and event triggered scheme (Type 3)

[173] The MDT modes can be set by the network in an MDMT configuration process. The network may transfer which MDT mode is to be set to the UE. Also, the network may indicate changing of only a set value while maintaining the same MDT mode.

- [174] For example, in FIG. 3 and/or FIG. 5, while configuring the MDT parameter (S710) or setting the event triggered MDT scheme (S910), the network may select an MDT mode and separately transfer corresponding information to the UE or include it in a log configuration request message, or the like, and transfer the same to the UE.
- [175] Also, when the network determines that it requires to change the MDT mode during the MDT measurement or before or after the MDT measurement, the network may configure a new MDT configuration related parameter, include the configured new MDT configuration related parameter in a log configuration request message, and transmit the same to the UE.
- [176] Also, the network may configure a new MDT configuration related parameter and separately transmit the same to the UE. Also, when a particular situation occurs or a particular condition is met according to a certain pre-set rule or instruction, the UE may change the MDT mode even without an explicit instruction from the network. Here, the certain pre-set rule or instruction may be included in a first log configuration request message and transmitted from the network to the UE, or the network may transmit the certain pre-set rule or the instruction to the UE when the network determines that a new condition or configuration is required.
- [177] The MDT mode may be any one of the classified operation modes such as a type 1: periodic only scheme, type 2: event triggered only scheme, and a type 3: a mixture scheme of the periodic scheme and the event triggered scheme.
- [178] Here, the network may configure information indicating any one of the three types and separately transfers the information to the UE or may include it in an MDT mode of a log configuration request message and transfer the same to the UE. Upon receiving the information regarding the MDT mode, the UE may configure a log environment according to the corresponding MDT mode (Refer to S730 and S930), and perform MDT measurement.
- [179] The foregoing three types of MDT modes may be newly set as necessary, or may be interchanged during the MDT measurement or before or after the MDT measurement.
- [180] MDT measurement may be changed to Type 3 while the MDT measurement is being made according to Type 1 or before or after the MDT measurement. While continuing the MDT measurement according to the periodic MDT configuration, the UE may perform MDT measurement when a certain triggering event occurs.
- [181] MDT measurement may be changed to Type 1 while the MDT measurement is being made according to Type 2 or before after the MDT measurement. The UE may terminate the event triggered MDT configuration and perform MDT measurement according to the periodic MDT configuration.
- [182] MDT measurement may be changed to Type 3 while the MDT measurement is being made according to Type 2 or before after the MDT measurement. The UE may

perform MDT measurement when a triggering event occurs according to the event triggered MDT configuration, and may perform MDT measurement according to the periodic MDT configuration.

- [183] MDT measurement may be changed to Type 1 while the MDT measurement is being made according to Type 3 or before after the MDT measurement. The UE may terminate the event triggered MDT configuration and the periodic MDT configuration and perform MDT measurement according to a new periodic MDT configuration. Also, the UE may terminate only the event triggered MDT configuration, and perform MDT measurement while maintaining only the periodic MDT configuration. A new periodic MDT configuration may be the same as the existing periodic MDT configuration. A new periodic MDT configuration may be different from the existing periodic MDT configuration.
- [184] MDT measurement may be changed to Type 2 while the MDT measurement is being made according to Type 3 or before after the MDT measurement. The UE may terminate the event triggered MDT configuration and the periodic MDET configuration and may perform MDT measurement according to the new event triggered MDT configuration. Also, the UE may terminate only the periodic MDT configuration, and perform MDT measurement while maintaining only the event triggered MDT configuration. The new event triggered MDT configuration may be different from the existing event triggered MDT configuration.
- [185] Here, the case in which the MDT mode is changed, namely, the case in which the MDT type is changed, has been described, but only the MDT configuration may be changed while the same type is maintained.
- [186] FIG. 6 is a schematic conceptual view explaining an example of creating a log in a mixture scheme using both a periodic scheme and an event triggered scheme.
- [187] With reference to FIG. 6, the UE performs measurement on a network communication environment according to configuration of a periodic MDT at every measurement point in time $T_1 \sim T_5$ according to an MDT measurement period T_M in an MDT measurement duration T_{on} . The measurement duration of the periodic MDT and/or the measurement period of the MDT may be variably configured as configuration parameters as necessary. The measurement period or measurement duration of the periodic MDT may be variably set as necessary, and in the example of FIG. 10, the measurement period T_M of the periodic MDT is set to be a multiple of DRX cycle T_d .
- [188] The UE may measure a network communication environment, or the like, according to the MDT configuration and create a log, measurement information. The log is continuously accumulated at every measurement and stored in a new log form in the UE. As shown in an example of a log illustrated in FIG. 6, a log may include a measured wireless communication environment value, a time stamp with respect to a mea-

surement time, measurement location information, or the like, along with a log number for identifying each log in measurement. Here, it is described that the log includes the measurement value with respect to a wireless communication environment, the time stamp, and the location information, but the present invention is not limited thereto and each log may include various types of information as necessary.

[189] When an event is triggered, the UE may measure a network communication environment according to the event triggered MDT configuration and create a corresponding log. The log may be differently configured according to types of events, or the like. For example, when a triggering event is changing of location information of the UE, a log with respect to the event triggered MDT may include location information of the UE and a time stamp at the time of measurement as illustrated.

[190] The log with respect to the periodic MDT and the log with respect to the event triggered MDT may be created/stored/managed/reported, or the like, according to different configurations, respectively, in the UE. Also, the UE may create/store/manage/report, or the like, the log with respect to the periodic MDT and the log with respect to the event triggered MDT according to partially or entirely same configuration as necessary. For example, in the case of the periodic MDT, the UE may report the log information to the network when there is an explicit report request from the network, and in the case of the event triggered MDT, the UE may report log information to the network when a certain condition is met even without an explicit report request from the network. Also, in the case of the event triggered MDT, when there is an explicit report request from the network, the UE report the log information to the network, and in the case of the periodic MDT, the UE may report the log information to the network when a certain condition is met even without an explicit report request from the network.

[191] FIG. 7 is a flow chart schematically explaining an operation of a network with respect to an MDT measurement.

[192] A network configures an MDT configuration parameter (S1110). In the case of the periodic MDT, the MDT configuration parameter may include information regarding an object of MDT measurement, a duration of MDT measurement, a period of MDT measurement, a log report scheme, a log report period, a time of a BS, or the like. Also, in the case of the event triggered MDT, the MDT configuration parameter may include information regarding a type of a triggering event, a log creation and/or location information report, or the like.

[193] The network transmits a log configuration request message including the MDT configuration parameter (S1120). The network may determine whether or not an MDT mode is required to be changed during the MDT measurement or before or after the MDT measurement (S1130). When the network determines that the MDT mode is

required to be changed, the network instructs the UE to change the MDT mode (S1140). In order to instruct the changing of the MDT mode, the network may create a new log configuration request message and transmit the same, or may transfer a separate message to the UE.

[194] In relation to the changing of the MDT mode, as for the changed MDT configuration, a new MDT configuration parameter may be configured by the network, included in a log configuration request message, and then transmitted to the UE. Also, a new MDT configuration parameter may be configured by the network and transmitted to the UE separately from the log configuration request message. Besides, the UE may change the MDT configuration according to a certain pre-set rule or instruction. Here, the certain pre-set rule or instruction may be included in the first log configuration request message and transmitted to the UE from the network, or may be transmitted to the UE when the network determines that a new condition or configuration is required.

[195] Here, it is described that the network determines whether or not the MDT mode is required to be changed and the instruction of changing the MDT mode is transferred to the UE, but the present invention is not limited thereto and the network may perform MDT measurement through one MDT mode.

[196] After the MDT measurement is completed or while the periodic MDT measurement is being performed, the network may request a log report from the UE (S1150), and when the UE transmits a log report in response to the log report request, the network receives the log report (S1160). Here, it is described that the network explicitly requests the log report from the UE, and receives it, but the present invention is not limited thereto and the network may receive the log report from the UE when a certain condition is met according to a predetermined rule or instruction without having to transfer the explicit log report request to the UE.

[197] FIG. 8 is a flow chart schematically explaining an operation of a UE with respect to an MDT measurement.

[198] The UE receives a log configuration request message from the network (S1210). In the case of the periodic MDT, the MDT configuration parameter may include information regarding an object of MDT measurement, a duration of MDT measurement, a period of MDT measurement, a log report scheme, a log report period, a time of a BS, or the like. Also, in the case of the event triggered MDT, the MDT configuration parameter may include information regarding a type of a triggering event, a log creation and/or location information report, or the like.

[199] The UE configures a log environment according to the MDT configuration parameter (S1220). For example, the UE performs MDT measurement according to the MDT configuration parameter and configures an environment to log it.

[200] Subsequently, the UE may determine whether or not there is an instruction regarding

changing of an operation mode from the network or whether or not a pre-set certain condition regarding changing of the MDT mode is met (S1230). When the UE determines that changing of the MDT mode is required, the UE may change the MDT mode according to an instruction from the network or according to a pre-set certain condition (S1240).

- [201] In relation to the changing of the MDT mode,
- [202] In relation to the changing of the MDT mode, as for the changed MDT configuration, a new MDT configuration parameter may be configured by the network, included in a log configuration request message, and then transmitted to the UE. Also, a new MDT configuration parameter may be configured by the network and transmitted to the UE separately from the log configuration request message. Besides, the UE may change the MDT configuration according to a certain pre-set rule or instruction. Here, the certain pre-set rule or instruction may be included in the first log configuration request message and transmitted to the UE from the network, or may be transmitted to the UE when the network determines that a new condition or configuration is required.
- [203] The UE may perform MDT measurement in the corresponding MDT mode and create/store/manage a log (S1250). When the periodic MDT and the event triggered MDT are mixedly used, the UE may create/store/manage/report a log with respect to the periodic MDT and a log with respect to the event triggered MDT according to different configurations, respectively. Besides, the UE may create/store/manage/report, or the like, the log with respect to the periodic MDT and the log with respect to the event triggered MDT according to partially or entirely same configuration as necessary.
- [204] After the MDT measurement and creating/storing/managing of the log, the UE may determine whether or not the MDT mode is to be changed again (S1260). When the UE determines that the MDT mode is to be changed, the UE changes the MDT mode (S1240), and accordingly, the UE may perform the MDT measurement and the log creation/storage/management again (S1250).
- [205] Here, it is described that the UE determines whether or not the MDT mode is to be changed, and changes the MDT mode, but the present invention is not limited thereto and the UE may perform MDT measurement while maintaining one MDT mode.
- [206] The UE receives an MDT log reporting request from the network (S1270) and transfers an MDT log report to the network in response (S1280). Here, it is described that the UE receives the log report request from the network and transfers the log report to the network in response, but the present invention is not limited thereto and the UE may transmit the log report to the network when a certain condition is met according to a predetermined rule or instruction even without an explicit log report request from the network.

- [207] Meanwhile, the MDT minimizes a driving test by using the UE within a cell. However, users continuously move along with UEs within a cell and a UE performing MDT may get out of a corresponding cell and change a BS.
- [208] Currently, not all BSs support the MDT. Also, even if all the BSs support MDT, all of the BSs may not support MDT with the same specification or the same scheme.
- [209] Even when the UE performing MDT gets out of the cell of the BS in which MDT is supported, the UE may continuously perform measurement and logging according to an MDT configuration received from the prior BS. Also, although the UE, which has been performing MDT according to the MDT configuration of the prior BS, enters a cell of a BS supporting different MDT from the MDT configuration of the prior BS, the UE can continue to perform measurement and logging according to the MDT configuration received from the prior BS.
- [210] If unnecessary MDT measurement is performed or if MDT measurement which does not fit a configuration is continued, the UE would unnecessarily consume power to cause a waste of a memory.
- [211] Thus, when the UE performs handover, it is required to control the MDT being performed. It is required to perform the MDT measurement of the UE and/or adjust an MDT measurement log report according to MDT performing situation of a target BS. For example, a configuration of the UE may be changed based on whether or not the target BS supports MDT or based on a MDT specification, or the like, to allow the UE to adapt to the changed cell environment. Also, the specification of the currently ongoing MDT and/or whether or not it supports the MDT of the UE, or the like, may be transferred also to the target BS in advance, to thus change the MDT configuration of the UE or stop unnecessary MDT performing.
- [212] MDT controlling according to handover may be performed along with a handover process between BSs and between a UE and a BS. Here, the MDT to be adjusted may be an MDT configured for a UE which is within a corresponding area by a higher node or which meets a particular condition. Also, the MDT to be adjusted may be an MDT configured for each UE through UE-specific signaling. For example, as described above, MDT set for each UE through signaling may include a periodic MDT and an event triggered MDT configured for each UE through signaling.
- [213] A method for controlling MDT according to handover performed between respective objects performing handover will be described with reference to the accompanying drawings.
- [214] <Source BS (SeNB) and target BS (TeNB) - use of handover preparation procedure>
- [215] When handover is performed between BSs, a source BS and a target BS perform handover preparation procedure.
- [216] FIG. 9 is a flow chart schematically explaining performing of an MDT control

procedure together with a handover preparation procedure performed between a source BS and a target BS in a system to which the present invention is applied. Message transmission and reception between the source BS and the target BS may be performed through an X2 interface or may be performed through other wired/wireless channels.

[217] The source BS receives a measurement report from a UE, and when the source BS determines that handover is required, the source BS starts a handover preparation procedure (S1510).

[218] In relation to MDT controlling, the source BS transmits an MDT request message and/or an MDT configuration message to the target BS (S1520). The MDT request message and/or the MDT configuration message may be included in a handover request message transmitted by the source BS to the target BS and transmitted in the handover procedure.

[219] The source BS may transmit an MDT request message to the target BS. The MDT request message is a message inquiring whether or not MDT is to be performed in the target cell. When the target BS receives the MDT request message, the target BS may determine that the MDT has been performed in the source BS and the source BS inquires that the MDT is to be continuously performed in the target cell. The MDT request message may be configured, for example, as shown in Table 1 below.

[220] Table 1

[Table 1]

{	
MDT_Release_Information	Information regarding MDT version or release
MDT_Available_Flag	Flag regarding availability of MDT
}	

[221] In Table 1, the MDT request message includes information regarding an MDT version or release and a flag regarding availability of MDT, but it may include information of the corresponding UE obtained by the source BS in relation to the MDT, MDT configuration information of the UE, or the like. Upon receiving the MDT request information, the target BS may recognize that the source BS has been currently performing the MDT and the UE subjected to handover is a UE supporting MDT.

[222] When the source BS transmits only the MDT request message to the target BS, additional information required for performing MDT, e.g., an MDT configuration message, may be transmitted by the target BS to the UE or may be obtained from the UE.

[223] The source BS may transmit MDT configuration information along with the MDT request information. In this case, MDT related information may be configured as shown in Table 2 below.

[224] Table 2

[Table 2]

{	
MDT_Release_Information	Information regarding MDT version or release
MDT_Available_Flag	MDT availability
{	
Absolute_Time_Information	Time information of BS (cell)
Logging_Duration	Log proceeding duration
Logging_Interval	Log proceeding interval
Area_Configuration	Log proceeding area information
Cell_Global_ID_List	Log-available cell ID list
Tracking_Area_Code_List	Log-available tracking area list
MDT_PLMN_ID	MDT-available PLMN ID
MDT_Event_Triggered_List	MDT-triggered event list
MDT_Event_Type1	MDT-triggered event type
MDT_Event_Type2	MDT-triggered event type
}	
}	

[225] The MDT configuration message includes configuration information regarding the MDT which has been performed in the source cell. For example, the MDT configuration message may include a parameter regarding a time of the BS by which a reference time for an MDT measurement and/or report can be known, a parameter regarding a logging period, a parameter regarding a log period or log interval, a parameter regarding an area in which MDT measurement is performed, a parameter regarding a PLMN(Public Land Mobile Network) ID available for MDT, a parameter regarding a list of triggering events, a parameter regarding an MDT triggering event type, and the like. The source BS may transmit all of information in relation thereto, transmit only required information according to the specification of the corresponding UE, the specification of the target BS, a network state, or the like, of the target BS, or the like, or may further include required information and transmit the same.

[226] In the case of the event triggered MDT, the parameter regarding the list of triggering events, which indicates information regarding corresponding triggering events, includes a parameter regarding types of MDT triggering events. As mentioned above, there may be various MDT triggering events, and the network may select a desired triggering event as necessary. For example, a case in which location information of the UE is updated, a case in which a network state measured by the UE is changed, a case

in which an operation of the UE or an operation of the BS fails, or the like, may be considered to be an event for which the event triggered MDT can be used.

[227] Here, as shown in Table 2, the MDT configuration message may be transmitted along with the MDT request message, or may be transmitted without the MDT request message in Table 1. Only the MDT configuration message without the MDT request message may be transmitted when the target BS can determine that there is a request regarding MDT performing from the source BS and that the source BS is performing MDT only with the MDT configuration message. In order to check the MDT request message and/or MDT configuration message, requirements that the target BS must be a version of a certain level or higher and must have a function supporting MDT, or the like, may be required. When the corresponding requirements are not met, the target BS may disregard the MDT request message and/or the MDT configuration message.

[228] The target BS checks the MDT request information and/or the MDT configuration information included in the handover request message and checks the state of MDT performed in the source BS (S1530). Checking of the MDT state by the target BS may be performed in a handover acceptance control step of the handover procedure.

[229] Even after the UE changes the BS to the target BS, the target BS determines whether or not the MDT performed in the source BS is required to be continued. The MDT may not be required to be performed when the target BS cannot support the MDT which has been supported in the source BS, or when the MDT is not required to be performed in a cell environment of the target cell, or the like. Here, that the MDT is not required to be performed means that the MDT measurement and log creation are not required to be performed in the same configuration as the MDT configuration in the source BS .

[230] Also, BSs supporting MDT may not support MDT with the same specification in the same manner. Also, when an MDT performing scheme required for the cell environment of the target cell is different from that of the source BS, the MDT configuration should be changed and performed. For example, if the target BS requires or supports an MDT triggered by a particular event, while if the source BS has performed a periodic MDT, then, the target BS may reset the MDT configuration in order to perform an event triggered MDT. Here, the target BS may check the MDT state based on the MDT request message and/or MDT configuration message transmitted from the source BS, and make required preparations.

[231] The target BS transmits an MDT availability indication message and/or an MDT re-configuration message to the source BS based on the checking of the MDT state (S1540). The MDT availability indication message and/or the MDT reconfiguration message may be included in a handover request ACK message and transmitted in the handover performing procedure.

[232] The MDT availability indication message is an indicator regarding as to whether or

not the target BS continues to perform the MDT. When the target BS determines to perform the MDT, the target BS may include ACK information in the MDT availability indication message and transmit the same. The target BS may perform the MDT according to the MDT configuration of the source BS or may reconfigure matters related to the MDT and then perform MDT. When the matters related to the MDT are to be reconfigured, the target BS may include only ACK information in the MDT availability indicator and transmit the same, or may additionally transmit a message including MDT reconfiguration information. When the target BS includes only the ACK information in the MDT availability indicator and transmits the same, the required reconfiguration information may be directly transferred to the UE through the network after the handover is completed.

[233] When the target BS determines not to perform MDT, the target BS includes NACK information in an MDT availability indication message and transmits the same. Also, when the target BS cannot process MDT-related information, for example, when the target BS disregards the MDT-related information, or the like, the target BS may transmit the handover request ACK message without the MDT availability indication message. In this case, the source BS may determine that the target BS does not support MDT.

[234] The MDT availability indication message may be configured, for example, as shown in Table below.

[235] Table 3

[Table 3]

{	
MDT_Release_Information	Information regarding MDT version or release
MDT_Available_Indication	MDT availability
}	

[236] The target BS may transfer information regarding whether or not the target BS can support MDT through information regarding an MDT version or release, and may transfer information regarding whether or not the target BS will perform MDT through the MDT availability flag as described above. In Table 3, the MDT availability indication message includes only the information regarding the MDT version or release and the indicator regarding MDT availability, but, for example, when the source BS transmits an MDT-related message including UE information, the MDT availability indication message may further include information regarding whether or not an MDT-

related function of the corresponding UE is supported by the target BS and/or information regarding a required specification, or the like.

[237] Also, the target BS may include an MDT reconfiguration message in the handover request ACK message, or the like, and transmit the same along with the MDT availability indication message. In this case, the MDT availability indication message and the MDT reconfiguration message may be configured as shown in Table below.

[238] Table 4

[Table 4]

{	
MDT_Release_Information	Information regarding MDT version or release
MDT_Available_Indication	MDT availability
{	
Absolute_Time_Information	Time information of BS (cell)
Logging_Duration	Log proceeding duration
Logging_Interval	Log proceeding interval
Area_Information	Log proceeding area information
Cell_Global_ID	Cell ID of target cell
Tracking_Area_Code	Tracking area ID of target cell
MDT_PLMN_ID	PLMN ID of target cell
MDT_Event_Triggered_List	List of MDT triggered event types desired by target cell
MDT_Event_Type1	MDT triggered event type
MDT_Event_Type2	MDT triggered event type
}	
}	

[239] The MDT reconfiguration message includes configuration information regarding MDT performed in or supported by the target cell. For example, the MDT configuration message may include a parameter regarding a time of the BS by which a reference time for an MDT measurement and/or report can be known, a parameter regarding a logging period, a parameter regarding a log period or log interval, a parameter regarding an area in which MDT measurement is performed, a parameter regarding a PLMN(Public Land Mobile Network) ID, a parameter regarding a list of triggering events, a parameter regarding an MDT triggering event type, and the like. The target BS may transmit all of information in relation thereto, transmit only required information according to the specification of the corresponding UE, the speci-

fication of the target BS, a network state, or the like, of the target BS, or the like, or may further include required information and transmit the same.

- [240] In the case of the event triggered MDT, the parameter regarding the list of triggering events, which indicates information regarding corresponding triggering events, includes a parameter regarding types of MDT triggering events. As mentioned above, there may be various MDT triggering events, and the network may select a desired triggering event as necessary. For example, a case in which location information of the UE is updated, a case in which a network state measured by the UE is changed, a case in which an operation of the UE or an operation of the BS fails, or the like, may be considered to be an event for which the event triggered MDT can be used.
- [241] Here, the MDT reconfiguration message may be transmitted along with the MDT availability indication message as shown in Table 4, or may be transmitted without the MDT availability indication message as shown in Table 3. Only the MDT reconfiguration message without the MDT availability indication message may be transmitted when the source BS can determine that the target BS determined to perform MDT, only by the MDT reconfiguration message.
- [242] The source BS determines whether to MDT is to be continued in the target cell based on the MDT availability indication message and/or the MDT reconfiguration message transmitted from the target BS (S1550). This determination may be performed along with a handover determination in the handover procedure. When ACK information is included in the MDT availability indication message transmitted from the target BS, the source BS may determine that the MDT is continued in the target cell. Also, when the target BS transmits the MDT reconfiguration message, the source BS may determine that the MDT is continued in the target cell.
- [243] <Source BS (SeNB) and UE - Handover>
- [244] FIG. 10 is a flow chart schematically explaining performing of an MDT control procedure together with a handover procedure performed between a UE and a source BS.
- [245] As described above, the source BS checks whether or not the MDT will be continued in the target cell based on the MDT availability indication message and/or the MDT reconfiguration message transmitted from the target BS (S1610). This determination may be performed along with a handover determination in the handover procedure.
- [246] The source BS transfers the MDT availability indication message and/or the MDT reconfiguration message to the UE (S1620). The MDT availability indication message and/or the MDT reconfiguration message transferred by the source BS to the UE may be included in a handover command or transmitted along with the handover command in the handover procedure. The handover command may be transferred through an RRC message which is transmitted from a BS to a UE, e.g., an RRC retransmission

message, or the like, to the UE.

[247] The source BS may transmit the MDT availability indication message and/or the MDT reconfiguration message transmitted from the target BS as it is to the UE, or may change the MDT availability indication message and/or the MDT reconfiguration message, such as extracting only a required portion, adding a required portion thereto, or the like, and transmit the same to the UE. For example, when the MDT cannot be performed in the target cell because MDT-related information has not been transmitted from the target BS or when the source BS determines that MDT is not required to be performed in the target cell, the source BS may include information indicating that MDT is stopped in the MDT availability indication message, and transmit the same.

[248] The MDT availability indication message transmitted by the source BS to the UE may be configured, for example, as shown in Table 5 below.

[249] Table 5

[Table 5]

{	
MDT_Available_Indication	MDT availability
}	

[250] The MDT availability indication message transmitted by the source BS includes information regarding whether or not MDT is available. The information regarding whether or not MDT is available may be implemented, for example, by providing ACK information when the MDT is continuously performed in the target cell, by providing NACK information when the MDT cannot be performed in the target cell, or the like. The MDT availability indication message may further include information regarding whether or not the MDT configuration of the target BS is different from that of the source BS, whether or not the MDT configuration is to be changed, what version or release the target BS is of, or the like, besides the information regarding whether or not MDT is available.

[251] When the source BS determines that the MDT is continued in the target cell so it transmits the MDT availability indication message to the UE, the source BS may transmit the MDT reconfiguration message together. Here, the MDT availability indication message and the MDT reconfiguration message may be configured as shown in Table 6 below.

[252] Table 6

[Table 6]

{	
MDT_Release_Information	Information regarding MDT version or release
MDT_Available_Indication	MDT availability
{	
Absolute_Time_Information	Time of BS (cell)
Logging_Duration	Log proceeding duration
Logging_Interval	Log proceeding interval
Area_Information	Log proceeding area information
Cell_Global_ID	ID of target cell
Tracking_Area_Code	Tracking area ID of target cell
MDT_PLMN_ID	PLMN ID of target cell
MDT_Event_Triggered_List	List of MDT triggered event types desired by target cell
MDT_Event_Type1	MDT triggered event type
MDT_Event_Type2	MDT triggered event type
}	
}	

[253] As shown in Table 6, the MDT availability indication message transmitted by the source BS to the UE may include information regarding what version or release the target BS is of. Information regarding MDT reconfiguration is required when the MDT is continuously performed in the target cell, so in this case, the information regarding whether or not the MDT is available may indicate that MDT is to be continuously performed in the target cell.

[254] The MDT reconfiguration message includes configuration information regarding MDT performed in or supported by the target cell. For example, the MDT configuration message may include a parameter regarding a time of the BS by which a reference time for an MDT measurement and/or report can be known, a parameter regarding a logging period, a parameter regarding a log period or log interval, a parameter regarding an area in which MDT measurement is performed, a parameter regarding a PLMN(Public Land Mobile Network) ID, a parameter regarding a list of triggering events, a parameter regarding an MDT triggering event type, and the like. The source BS may transmit all of information in relation thereto, transmit only required information according to the specification of the corresponding UE, the specification of the target BS, a network state, or the like, of the target BS, or the like, or

may further include required information and transmit the same.

- [255] In the case of the event triggered MDT, the parameter regarding the list of triggering events, which indicates information regarding corresponding triggering events, includes a parameter regarding types of MDT triggering events. As mentioned above, there may be various MDT triggering events, and the network may select a desired triggering event as necessary. For example, a case in which location information of the UE is updated, a case in which a network state measured by the UE is changed, a case in which an operation of the UE or an operation of the BS fails, or the like, may be considered to be an event for which the event triggered MDT can be used.
- [256] Here, the MDT reconfiguration message may be transmitted along with the MDT availability indication message as shown in Table 6, or may be transmitted without the MDT availability indication message as shown in Table 6. Even when only the MDT reconfiguration message is transmitted without the MDT availability indication message, the UE can determine that MDT will be performed in the target cell, by the new MDT configuration included in the MDT reconfiguration message.
- [257] Upon receiving the MDT availability indication message and/or the MDT reconfiguration message from the source BS, the UE may maintain the MDT configuration, stop the MDT, or change the MDT configuration based on the received messages (S1630).
- [258] As described above, when the source BS indicates that MDT is not required to be performed through the MDT availability indication message, the MDT measurement and/or log creation may be stopped after a completion of handover. In this case, the log created after measurement may be transmitted to the BS, discarded, or kept in storage according to an instruction from the network/BS.
- [259] When the source BS indicates that the MDT is continued through the MDT availability indication message, the UE may continuously perform MDT while maintaining the current MDT configuration.
- [260] When the MDT reconfiguration message is transmitted along with the MDT availability indication message, or when only the MDT reconfiguration message is transmitted, the UE may change the MDT configuration or may make preparations to change the MDT configuration even before the completion of handover, in order to continuously perform the MDT.
- [261] Also, even when only the indication that MDT will be continued is transmitted through the MDT availability indication message without the MDT reconfiguration message, the configuration of the UE may be changed according to an MDT state of the target BS after handover to the target BS is completed.
- [262] In addition, even when the MDT reconfiguration message and the MDT availability indication message are not transmitted to the UE, MDT controlling with respect to the

UE may be set by an instruction of the network/BS in advance. For example, it may be set such that the MDT configuration is maintained and the MDT is continued when handover is performed without transmission of the MDT reconfiguration message and the MDT availability indication message. Also, conversely, it may be set such that the MDT performing is stopped when handover is performed without transmission of the MDT reconfiguration message and the MDT availability indication message.

[263] The UE may continuously perform MDT after handover is performed according to the configuration to be changed, or may stop MDT performing after handover based on an MDT performing stop message from the source BS.

[264] A method for performing MDT controlling by each subject which performs a handover procedure will be described with reference to the accompanying drawings.

[265] FIG. 11 is a flow chart schematically explaining MDT controlling performed by a source BS when a handover procedure is performed.

[266] With reference to FIG. 11, the source BS receives a measurement report from the UE (S1710). The source BS determines whether or not handover with respect to the corresponding UE is required based on the measurement report from the UE.

[267] When the source BS determines that handover is required, the source BS transmits an MDT request message and/or an MDT configuration message to the target BS (S1720). Here, the MDT request message and/or the MDT configuration message may be included in a handover request message, which is transmitted by a source BS to a target BS in the handover procedure, and transmitted.

[268] The source BS receives an MDT availability indication message and/or an MDT reconfiguration message including information regarding a determination of the target BS with respect to the MDT based on the MDT request message and/or the MDT configuration message (S1730). The MDT availability indication message and/or the MDT reconfiguration message may be included in a handover request ACK message and transmitted from the target BS in the handover performing procedure. The MDT availability indication message includes information regarding whether or not MDT will be continuously performed in the target cell. The MDT reconfiguration message includes information indicating that MDT will be continued in the target cell, and when the MDT configuration of the source BS is different from that of the target BS, the MDT reconfiguration message includes information regarding the MDT configuration of the target BS.

[269] The source BS checks whether the MDT will be continued in the target cell based on the MDT availability indication message and/or the MDT reconfiguration message (S1740). This determination may be performed along with a handover determination in the handover procedure.

[270] The source BS configures an MDT availability indication message including in-

formation regarding whether or not MDT will be continued in the target cell and/or an MDT reconfiguration message and transmit the same to the UE (S1750). The MDT availability indication message and/or the MDT reconfiguration message transferred by the source BS to the UE may be included in a handover command or transmitted along with the handover command in the handover procedure. The handover command may be transferred through an RRC message which is transmitted from a BS to a UE, e.g., an RRC retransmission message, or the like, to the UE. The MDT availability indication message and/or the MDT reconfiguration message, which have been transmitted from the target BS, may be transmitted as it is to the UE, or required information may be extracted therefrom by the source BS or added thereto by the source BS and then transmitted.

- [271] FIG. 12 is a flow chart schematically explaining MDT controlling performed by a target BS when a handover procedure is performed.
- [272] The target BS receives an MDT request message and/or an MDT configuration message from the source BS (S1810). The MDT request message and/or the MDT configuration message may be included in a handover request message, which is transmitted by a source BS to a target BS in the handover procedure, and transmitted.
- [273] The target BS checks the MDT request information and/or the MDT configuration information included in the handover request message and checks the state of MDT performed in the source BS (S1820). Checking of the MDT state by the target BS may be performed in the handover acceptance control step of the handover procedure.
- [274] The target BS transmits an MDT availability indication message and/or an MDT reconfiguration message to the source BS based on the checking of the MDT state (S1830). The MDT availability indication message and/or the MDT reconfiguration message may be included in a handover request ACK message and transmitted in the handover performing procedure.
- [275] FIG. 13 is a flow chart schematically explaining MDT controlling performed by a UE when a handover procedure is performed.
- [276] The UE measures communication quality of a serving cell currently providing a service and communication quality of neighbor cells near the serving cell continuously or at every particular point in time. The UE transmits a measurement report regarding the measurement results to the source BS (SeNB) (S1910). The measurement report includes information determined according to a measurement report configuration. For example, the measurement report may include measurement values regarding a cell state which can be measured such as an RSRP, an RSRQ, or the like, of the cell.
- [277] The UE receives an MDT availability indication message and/or an MDT reconfiguration message from the source BS (S1920). The MDT availability indication message and/or the MDT reconfiguration message may be received in a state of being

included in a handover command or may be received along with the handover command in the handover procedure.

- [278] The UE may maintain the MDT configuration, stop the MDT, or change the MDT configuration based on the MDT availability indication message and/or the MDT re-configuration message received from the source BS (S1930).
- [279] FIG. 14 is a schematic block diagram of a wireless communication system in which an embodiment of the present invention is implemented.
- [280] With reference to FIG. 14, a BS 1400 includes a processor 1410, an RF unit 1430, and a memory 1420. The processor 1410 implements the proposed functions, procedures and/or methods.
- [281] The processor 1410 may configure an MDT configuration parameter and create a log configuration request message. Also, the processor 1410 may determine whether or not an MDT mode is required to be changed, and create a message instructing the UE to change the MDT mode. When the processor 1410 determines that log information is required, the processor 1410 may create a message requesting log information from the UE, and process a log report transmitted from the UE in response. Also, during a process in which handover occurs, the BS 1400 may be a source BS or a target BS. Here, the processor 1430 may transfer information regarding whether or not the BS 1400 can support MDT by using information regarding an MDT version or release. Or, the processor 1410 may transfer information regarding whether to perform MDT by using a flag regarding MDT availability. Or, the processor 1410 may further configure relevant information for supporting MDT and/or information regarding a required specification, or the like, and transmit the same through the RF unit 1430. Here, the processor 1410 may control the RF unit 1430 to configure a handover request message (MDT availability indication message) or an MDT reconfiguration message to transmit the MDT-related information.
- [282] Here, the relevant information for supporting MDT may include at least one among information regarding a time of the BS 1400, information regarding a duration in which log for MDT is proceeding, information regarding a log period/interval, information regarding an area in which MDT measurement is performed, information regarding a PLMN (Public Land Mobile Network) ID available for MDT, information regarding a list of MDT triggering events, and information regarding types of MDT triggering events. Also, layers of a radio interface protocol may be implemented by the processor 1410.
- [283] The memory 1420, connected to the processor 1410, may store various types of information for driving the processor 1410. In relation to MDT measurement, the memory 1420 may store, for example, certain conditions, rules, indications previously set between UEs. Also, the memory 1420 may store a log report received from a UE.

- [284] The RF unit 1430, connected to the processor 1410, transmits and/or receives a radio signal. The RF unit 1430 may transmit a log configuration request message created by the processor 1410, a message indicating changing of an MDT operation, or the like, to the UE. Also, the RF unit 1430 may receive a log information report transmitted by the UE, and transmit or receive information related to handover.
- [285] The UE 1440 may include an RF unit 1450, a memory 1460, a processor 1470, a signal measurement unit 1480, a log creation unit 1490, and the like.
- [286] The processor 1470 implements the proposed functions, procedures and/or methods. Layers of a radio interface protocol may be implemented by the processor 1470.
- [287] The processor 1470 measures communication quality of a serving cell currently providing a service and communication quality of neighbor cells near the serving cell continuously or at every particular point in time, and then, performs a measurement report regarding the corresponding measurement results or perform a log report with respect to MDT measurement according to an embodiment of the present invention. Here, the measurement report may include measurement values regarding a cell state which can be measured such as an RSRP, an RSRQ, or the like, of the cell. Here, the processor 1470 may configure a log environment for MDT measurement according to an MDT configuration parameter received from the BS 1400. In case of an event triggered MDT, the processor 1470 may determine whether or not triggering event has occurred.
- [288] Also, the processor 1470 may maintain an MDT configuration, stop the MDT, or change the MDT configuration based on an MDT availability indication message and/or an MDT reconfiguration message received from the BS 1400. Also, in relation to the MDT measurement, the processor 1470 may transmit an MDT triggering event type, an MDT version or release information, or the like. Here, the information related to the MDT measurement may further include at least one among information regarding a duration in which log for MDT is proceeding, information regarding a log period/interval, information regarding an area in which MDT measurement is performed, information regarding the UE 1440, information regarding a list of MDT triggering events, and information regarding types of MDT triggering events.
- [289] The memory 1460, connected to the processor 1470, stores various types of information for driving the processor 1470. The memory 1470 may store/manage a log created according to MDT measurement.
- [290] The RF unit 1450, connected to the processor 1470, transmits and/or receives a radio signal. The RF unit 1450 may receive a log configuration request message or a message indicating changing of an MDT mode from the BS, and transmit a created log information report, or the like. Also, the RF unit 1350 may receive the MDT related information through a handover request message (MDT availability indication message)

or through an MDT reconfiguration message.

[291] The signal measurement unit 1480, connected to the processor 1470, may perform MDT measurement according to an MDT configuration. The log creation unit 1490, connected to the processor 1470, may create a log according to an MDT measurement value measured by the signal measurement unit 1480.

[292] The processor 1410 and the processor 1470 may include an ASIC (Application-Specific Integrated Circuit), a chip-chip, a logical circuit and/or a data processor. The memories 1420 and 1460 may include a ROM (Read-Only Memory), a RAM (Random Access Memory), a flash memory, a memory card, a storage medium, and/or any other storage devices. The RF units 1430 and 1450 may include a baseband circuit for processing a radio signal.

[293] When the embodiments are implemented by software, the foregoing techniques may be implemented by modules (processes, functions, or the like) performing the foregoing functions. The modules may be stored in the memories 1420 and 1460 and executed by the processor 1410 and the processor 1470. The memories 1420 and 1460 may be provided within or outside the processor 1410 and the processor 1470, respectively, or may be connected to the processor 1410 and the processor 1470 through a well-known unit, respectively.

[294] Control information transferred from a higher layer described in the present disclosure may also be transmitted via a physical control channel, and may be periodically or aperiodically updated according to a request from a BS or a UE or according to a predetermined certain rule or instruction.

[295] In the exemplary system as described above, the methods are described based on the flow chart by sequential steps or blocks, but the present invention is not limited to the order of the steps, and a step may be performed in different order from another step as described above or simultaneously performed. It would be understood by a skilled person in the art that the steps are not exclusive, a different step may be included, or one or more of the steps of the flow chart may be deleted without affecting the scope of the present invention.

[296] The preferred embodiments of the present invention have been described with reference to the accompanying drawings, and it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope of the invention. Thus, the technical idea of the present invention should be interpreted to embrace all such alterations, modifications, and variations in addition to the accompanying drawings.

Claims

- [Claim 1] A method for collecting information using an MDT (Minimization Driving Test) in a wireless communication system, the method comprising:
transmitting a log configuration request message for an MDT;
requesting a log report; and
receiving a log report,
wherein the log report is generated by at least one MDT mode of a periodic MDT mode and an event triggered MDT mode, and in requesting the log report, MDT mode information indicating the at least one MDT mode is transferred.
- [Claim 2] The method of claim 1, wherein the MDT mode information indicating the MDT mode indicates changing of a current MDT mode of the log report into a certain MDT mode, and a log report received after the MDT mode information is transmitted is generated by the certain MDT mode.
- [Claim 3] The method of claim 2, wherein the certain MDT mode is an event triggered MDT mode, and the report includes information measured as a certain event occurs.
- [Claim 4] The method of claim 1, wherein the log configuration request message includes an MDT configuration parameter, and the MDT configuration parameter may include parameters regarding at least one of an object of an MDT measurement, a duration of an MDT measurement, a period of an MDT measurement, a log report scheme, a log report period, a time of a base station, and an occurrence of a triggering event initiating an MDT measurement.
- [Claim 5] The method of claim 1, wherein further comprising:
determining whether the MDT configuration is required to be changed;
and
when it is determined that the MDT configuration is required to be changed, a new MDT parameter is configured and transmitted.
- [Claim 6] A method for collecting information using an MDT (Minimization Driving Test) in a wireless communication system, the method comprising:
transmitting a log configuration request information for an MDT;
indicating changing of an MDT configuration; and
receiving a log report,

wherein, in the indicating of changing of an MDT configuration, an MDT mode is designated as at least one of a periodic MDT mode and an event triggered MDT mode.

[Claim 7] The method of claim 6, wherein the log configuration request message includes an MDT configuration parameter, and the MDT configuration parameter includes parameters regarding at least one of an object of an MDT measurement, a duration of an MDT measurement, a period of an MDT measurement, a log report scheme, a log report period, a time of a base station, and an occurrence of an event in the MDT mode and the event triggered MDT mode.

[Claim 8] The method of claim 6, wherein the indicating of changing of an MDT configuration comprises transmitting a log configuration request message including a new MDT configuration parameter, or transmitting a new MDT configuration parameter as a separate message.

[Claim 9] A method for transmitting information using an MDT (Minimization Driving Test) in a wireless communication system, the method comprising:
setting a log environment based on an MDT configuration parameter included in a log configuration request message;
performing an MDT and creating a log according to the set log environment; and
transmitting a log report regarding the created log,
wherein the MDT is performed by any one of a periodic MDT mode, an event triggered MDT mode, and a mixture mode of mixedly using the periodic MDT and the event triggered MDT, and the MDT mode is changed according to an MDT mode indication or an occurrence of a certain event.

[Claim 10] The method of claim 9, wherein the MDT mode indication is included in the log configuration request message or is received through a separate message, and when the MDT mode indication indicates the periodic MDT mode, a current MDT performing mode is changed into the periodic MDT mode in which a measurement regarding an MDT is periodically performed, when the MDT mode indication indicates the event triggered MDT mode, the current MDT performing mode is changed into the event triggered MDT mode in which a measurement regarding an MDT is performed when a certain event occurs, and when the MDT mode indication indicates the mixture mode, the current MDT performing mode is changed into the mixture mode in which the

periodic MDT mode and the event triggered MDT mode are performed together.

[Claim 11]

The method of claim 9, wherein the information regarding a certain event for changing the MDT mode is included in the MDT configuration parameter included in the log configuration request message.

[Claim 12]

The method of claim 9, wherein the log configuration request message includes the MDT configuration parameter, and the MDT configuration parameter includes parameters regarding at least one of an object of an MDT measurement, a duration of an MDT measurement, a period of an MDT measurement, a log report scheme, a log report period, a time of a base station, the MDT mode, an occurrence of an event in the event triggered MDT mode, and an occurrence of an event for changing the MDT mode.

[Claim 13]

An apparatus for collecting information, the apparatus comprising: processor configuring MDT (Minimization Driving Test) parameter and log configuration request for MDT ; and RF (Radio Frequency) unit transmitting the log configuration request and log report request, and receiving log report, wherein the log report is generated by at least one MDT mode of a periodic MDT mode and an event triggered MDT mode, and the log report request includes MDT mode information indicating the at least one MDT mode.

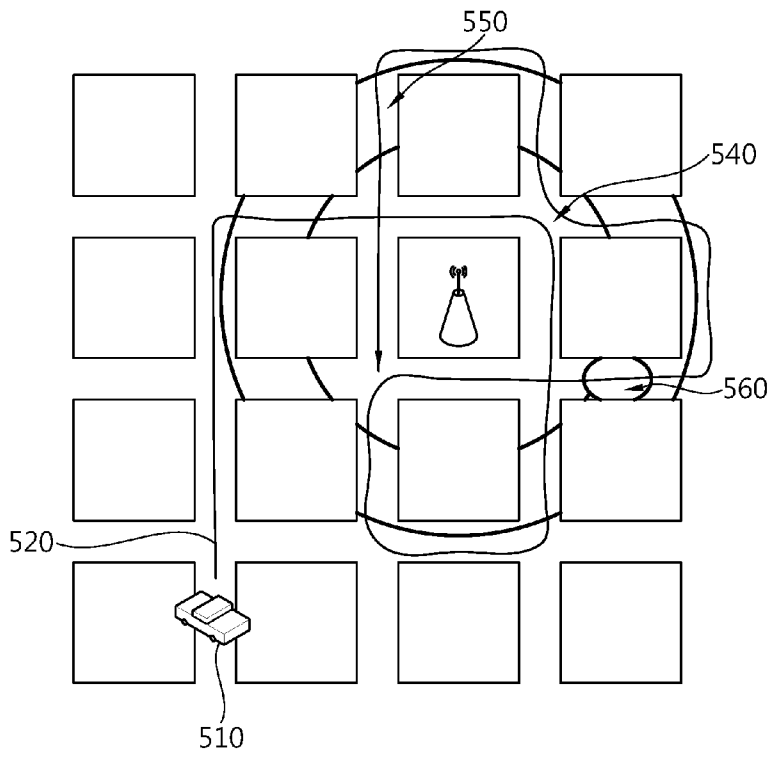
[Claim 14]

The apparatus of claim 13, wherein the processor configures change request for changing MDT configuration and transmitting the change request through the RF unit, and the change request indicates one of the periodic MDT mode and the event triggered MDT mode.

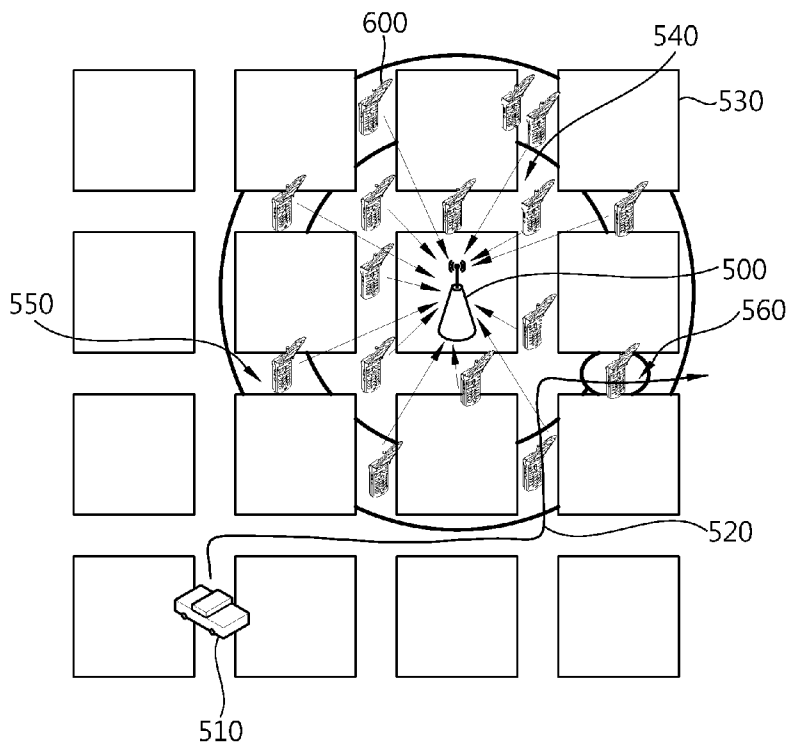
[Claim 15]

An apparatus for transmitting information , the apparatus comprising: processor setting a log environment based on an MDT (Minimization Driving Test) parameter and creating a log with MDT; and RF (Radio Frequency) unit transmitting a log report regarding the created log, wherein the MDT is performed by any one MDT mode of a periodic MDT mode, an event triggered MDT mode, and a mixture mode of mixedly using the periodic MDT and the event triggered MDT, and the MDT mode is changed according to an MDT mode indication or an occurrence of a certain event.

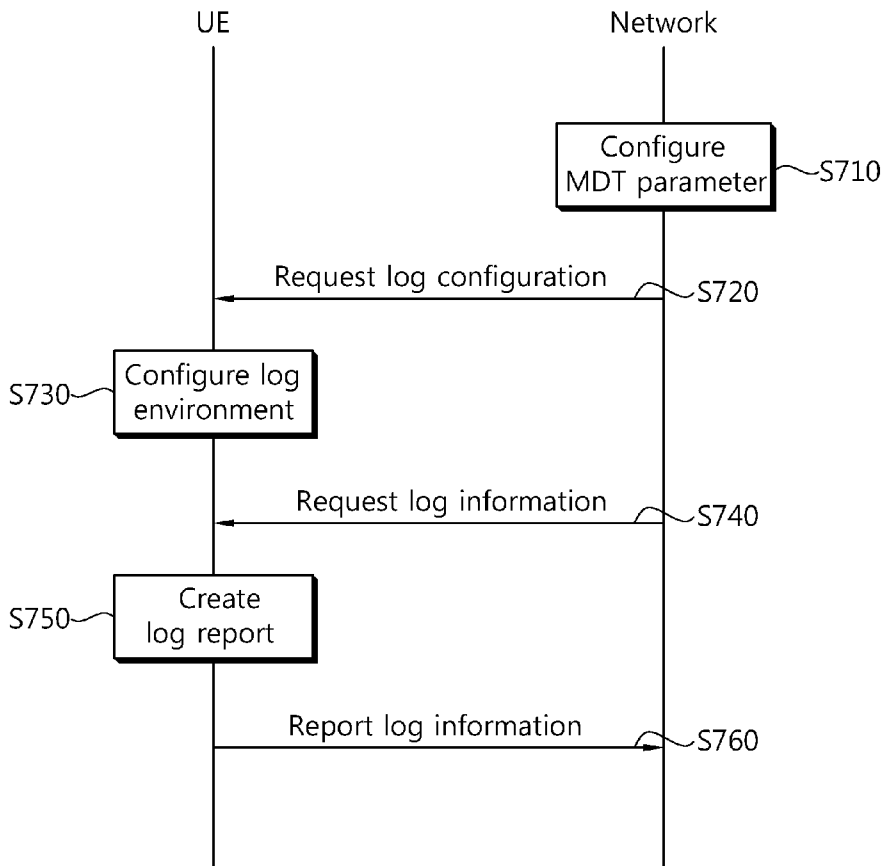
[Fig. 1]



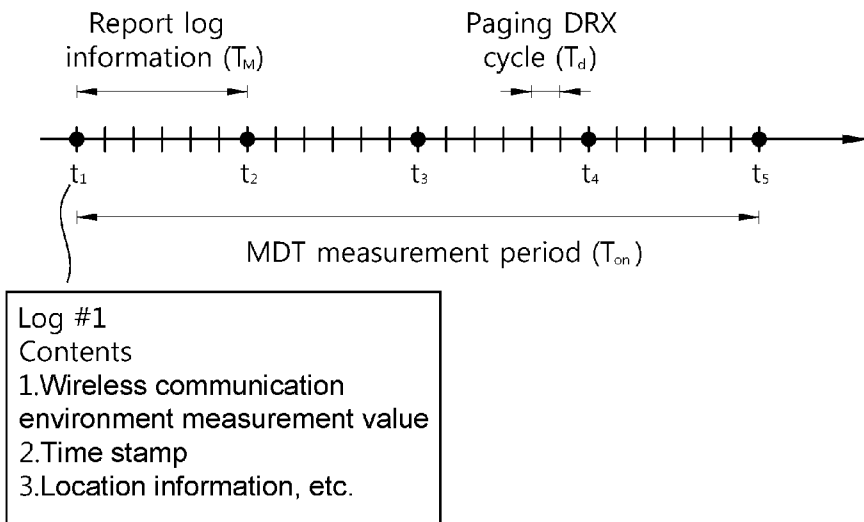
[Fig. 2]



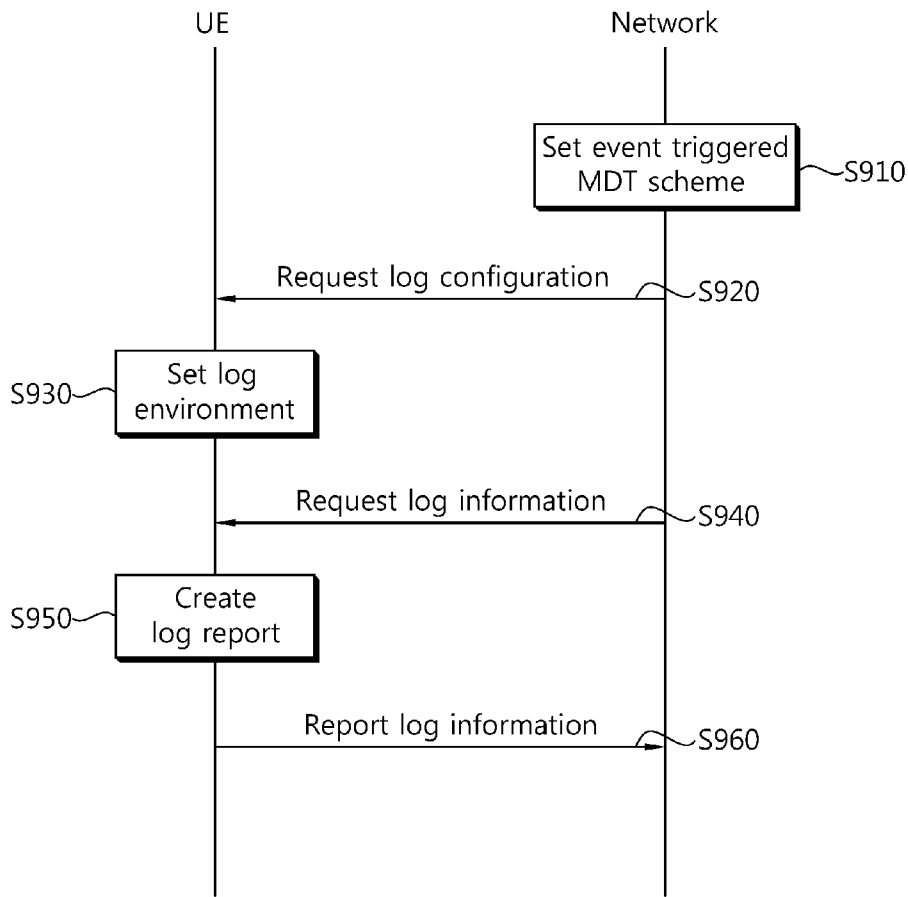
[Fig. 3]



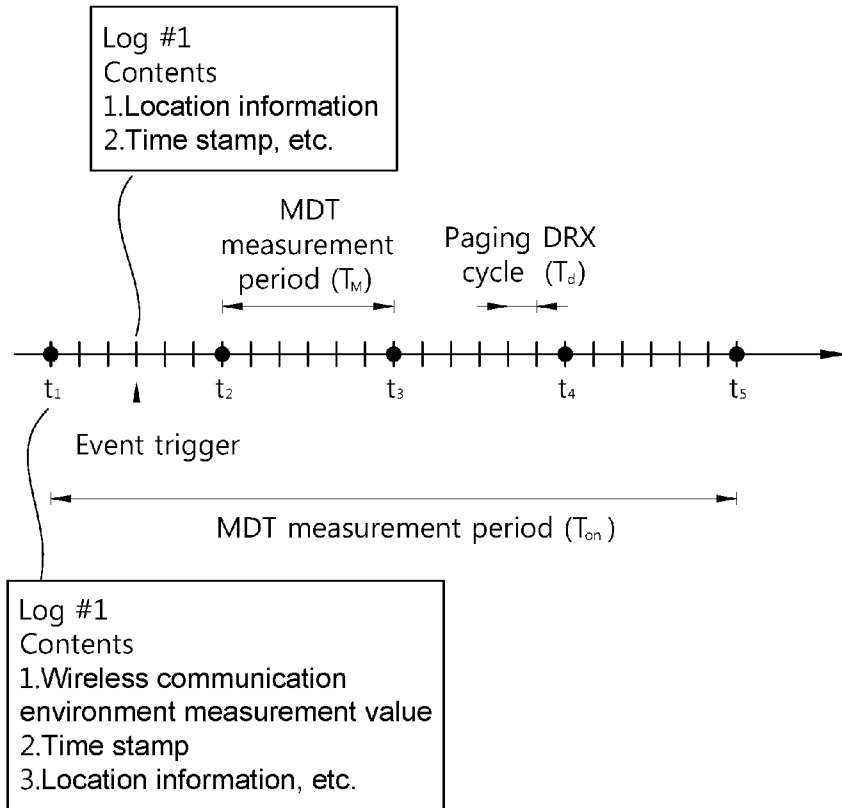
[Fig. 4]



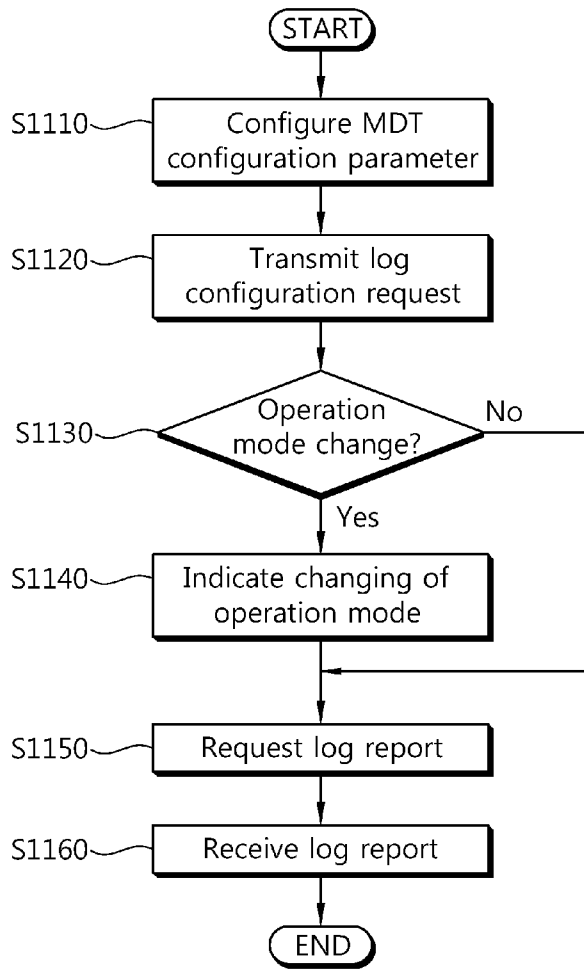
[Fig. 5]



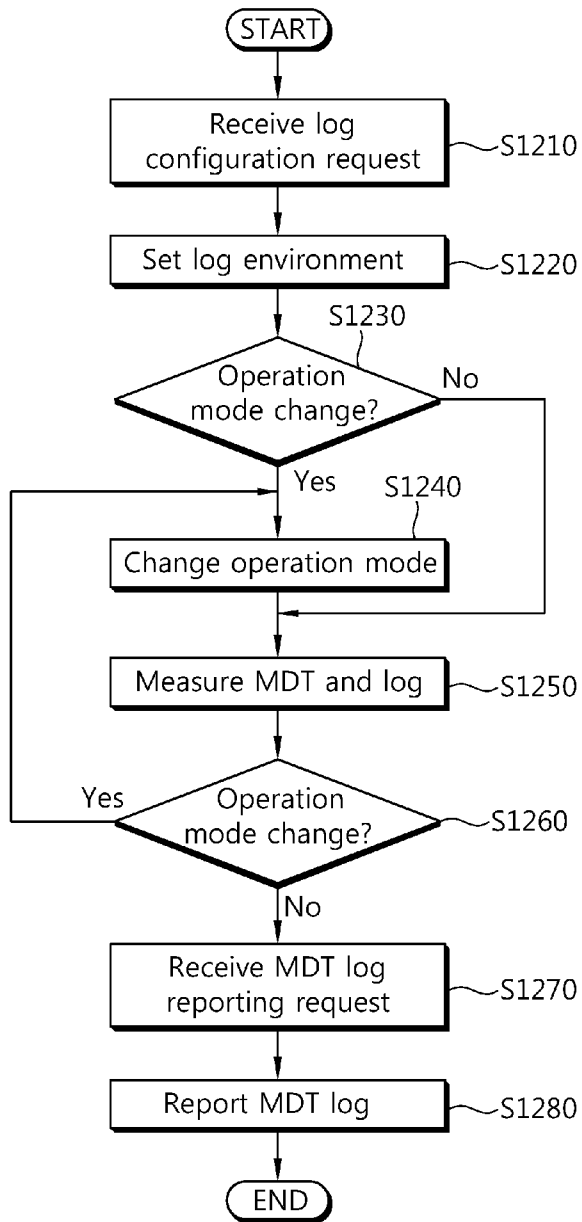
[Fig. 6]



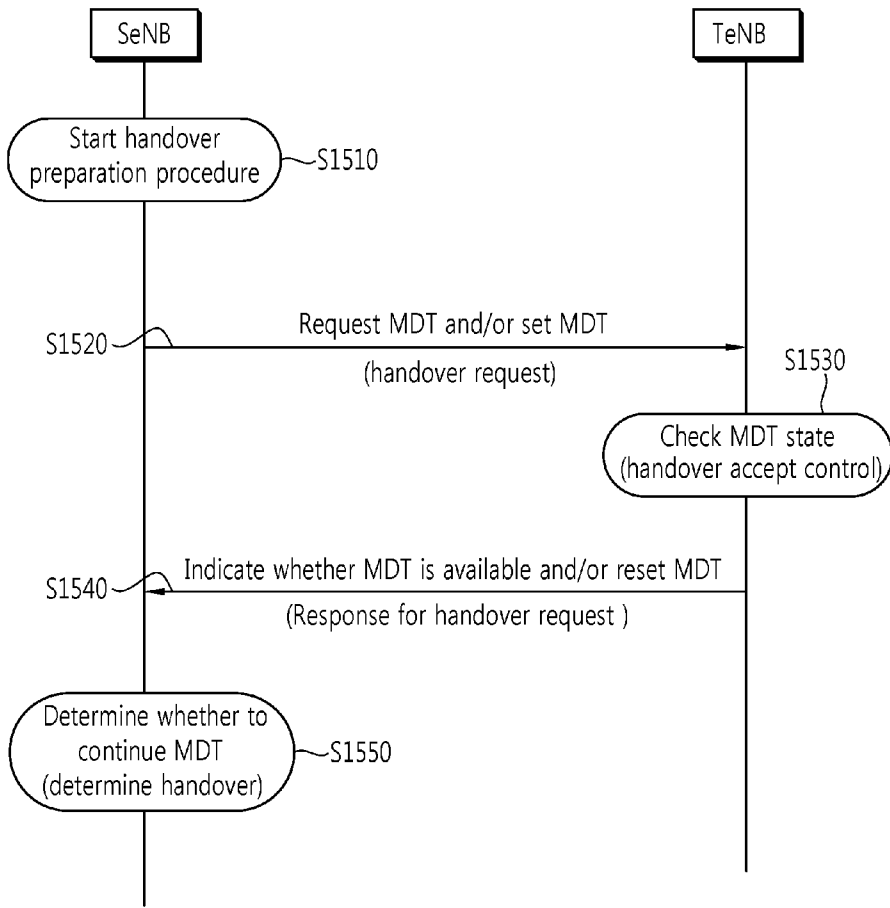
[Fig. 7]



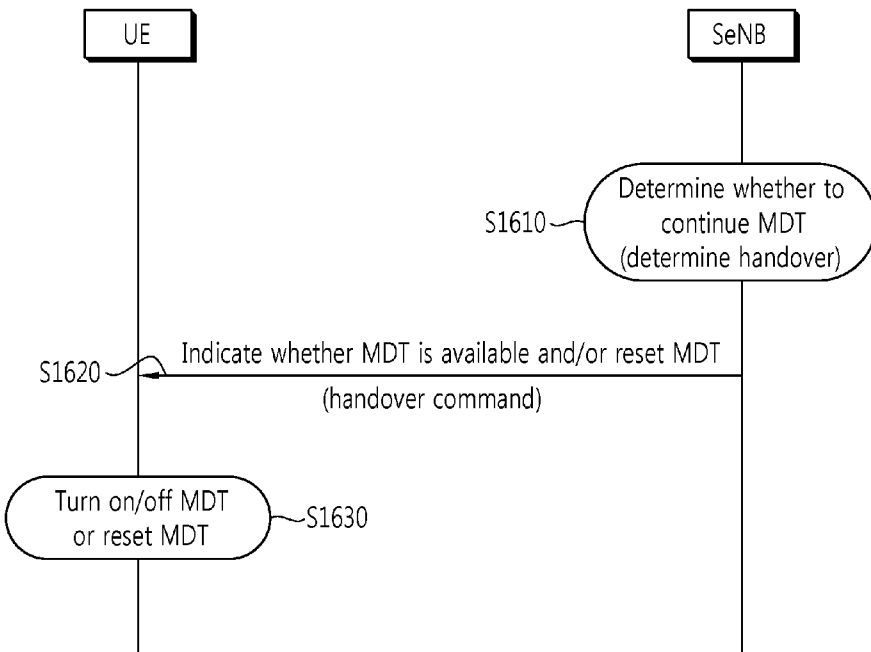
[Fig. 8]



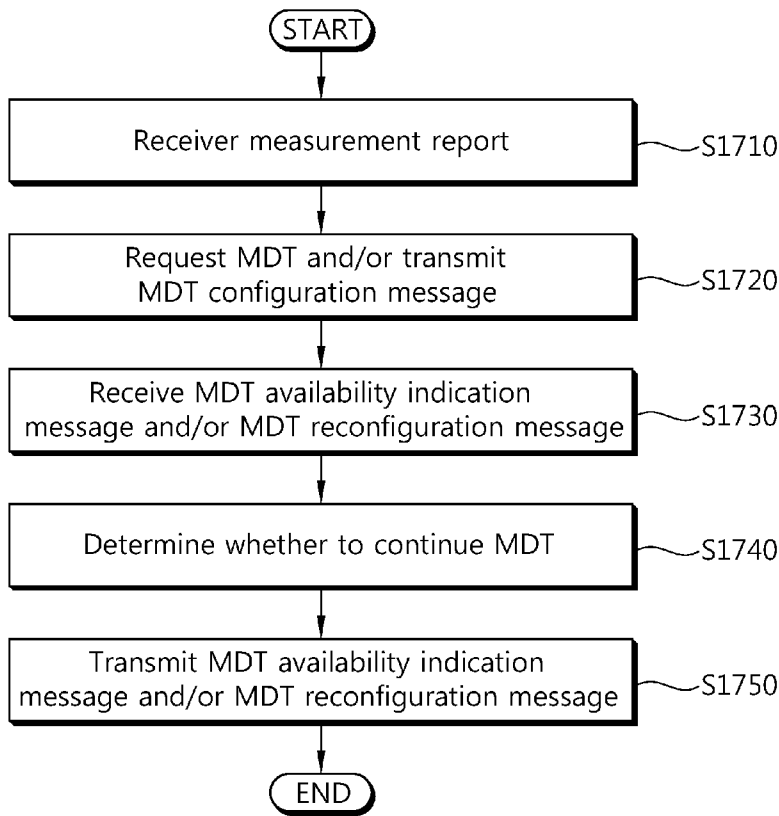
[Fig. 9]



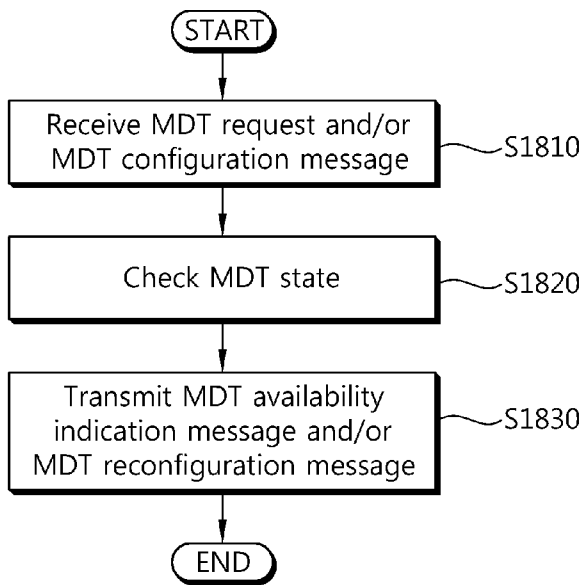
[Fig. 10]



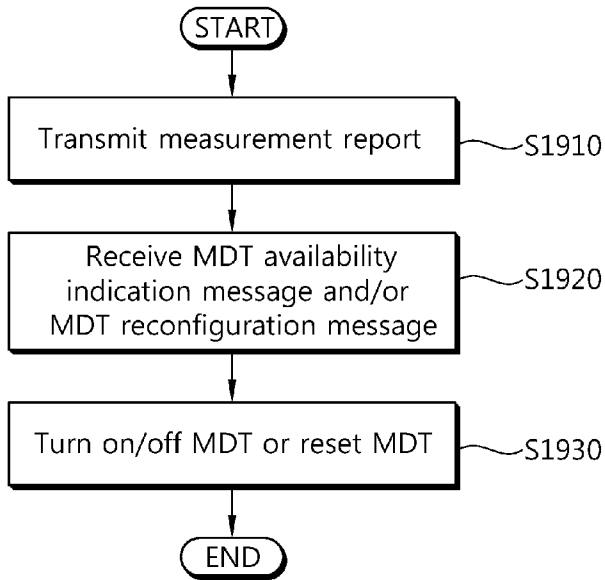
[Fig. 11]



[Fig. 12]



[Fig. 13]



[Fig. 14]

